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6 JULY 1956

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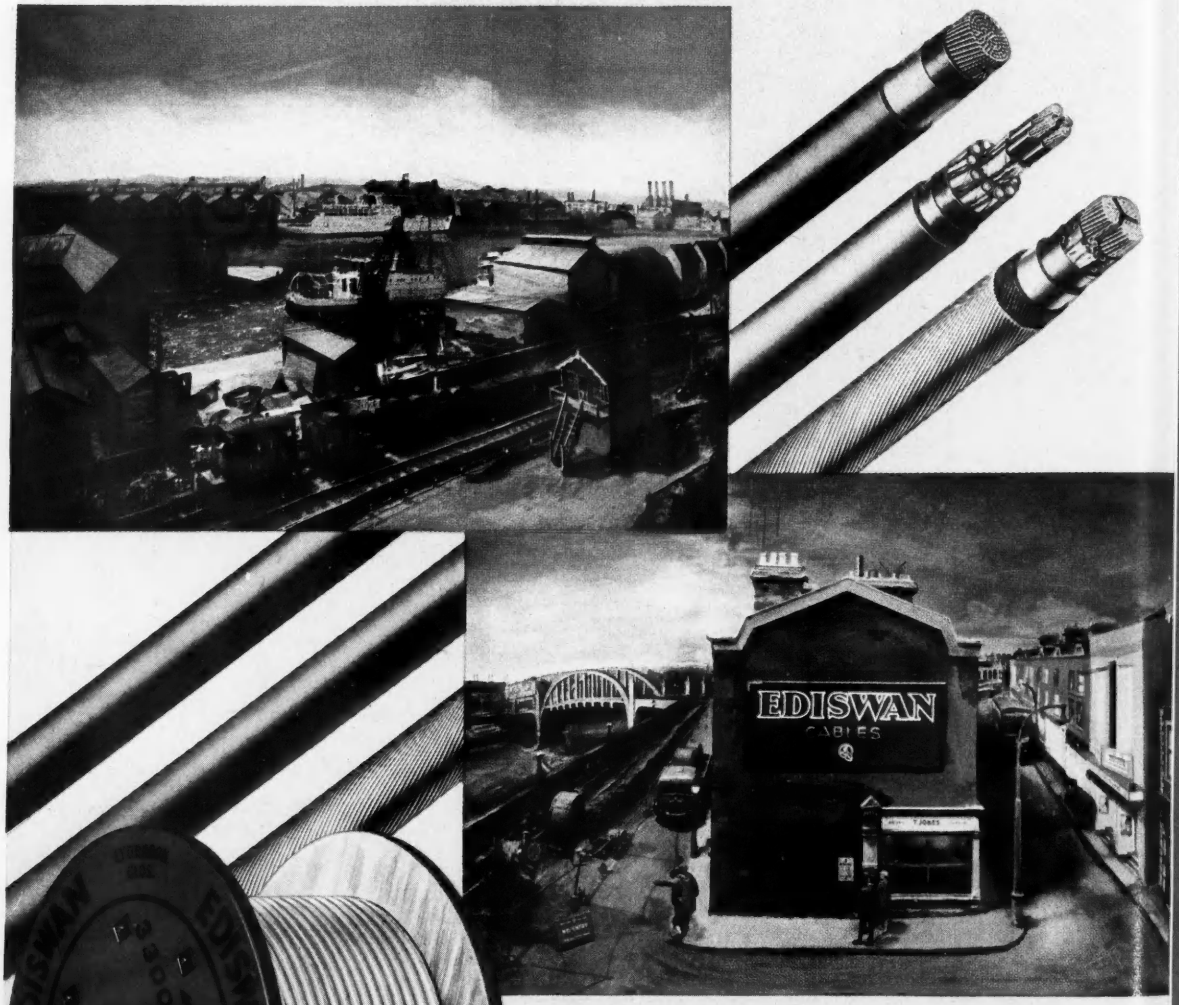

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ELECTRICAL REVIEW

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6 JULY 1956

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VOLUME 159 ◇ NUMBER 1

Eighty-Fourth Year of Publication

FRIDAY ◇ PRICE 1s 6d

115 *CLASSIFIED ADVERTISEMENTS*
130 *INDEX TO ADVERTISERS*

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ELECTRICAL REVIEW

6 July 1956 Vol. 159 No. 1 Established 1872

Contractors' Interests

WHILE it may be truly said that the Electrical Contractors' Association's Conference at Eastbourne last week was a success, as these conferences always are, from the outsider's point of view there was something lacking. Some of the members may have felt it too.

In our last issue " Reflector " drew attention to the leading article in the *I.E.E. Journal* in which it was stressed that the installation-contractor member of the Institution was a professional engineer in the fullest sense. That aspect of the installation business was missed at this year's conference.

It is true that the President, Mr. R. A. Marryat, touched upon some technical matters, e.g., the I.E.E. Wiring Regulations and installation inspection, but he was naturally unable within the compass of a presidential address to do more than refer to them quite briefly. The one paper was strictly financial and the points put to the " Any Questions ? " panel were very largely of the same character or covered closely allied matters. There were references to " service " (which, it was assumed, was only provided by electrical contractors and retailers), and the testing of appliances received cursory attention.

Electrical contractors, we suppose, are primarily in business to make a living, but we have always considered them to be something more than mere tradesmen. For this reason we have come to expect at least a little technical leavening in the proceedings at their conferences. We can recall past papers dealing, on a very high standard, with such subjects as new techniques in installation work, emergency lighting systems, electronics, lighting applications, etc.

We particularly remember the last pre-war conference when five authors presented accounts of advances in installation practice. It is noteworthy that one of them was this year's President who dealt with air-insulated busbar installations. Since the war there has been a trend away from practice towards commercial aspects, but even the commercial papers have had a technical flavouring as a rule.

Two topics which should have received more attention this year are apprentice training and installation inspection. The first is vital to the electrical contracting industry, for where will it be if there is an inadequate supply of the right young men properly equipped for the job ? And the establishment of the National Inspection Council (dealt with by Mr. P. V. Hunter in last week's issue) is another thing which will affect the contractor considerably. Although the new scheme is ostensibly a voluntary one its influence will be greater than anything we have had in the past and it was

disappointing that no questions were raised about it.

It is probable that the proceedings were agreeable enough to the majority of the members and that may be accepted as a justification, but we suggest that some regard might be paid to the wider audience represented by other branches of the electrical industry who are interested in what contractors want, technically as well as commercially.

NUCLEAR POWER DEVELOPMENTS

When Calder Hall generating station is officially opened in October, H.M. The Queen will operate a switch to feed electrical power into the national grid system. This will be the first full-scale nuclear power station to go into commercial operation anywhere in the world and in a sense the occasion will mark the commencement of the age of nuclear power. The Calder Hall reactor is of the gas-cooled graphite-moderated type and the nuclear power stations to be built in Stage I of the C.E.A. power programme will be substantially of the same design, but in view of the progress which is being made by the Atomic Energy Authority in its research work there is no doubt that these power stations will be a great improvement on Calder Hall. Furthermore, they will be economical and it is fairly obvious that successively improved designs will be built throughout the 1960's.

Two other types of reactor are at present being investigated, the first using water to surround the uranium rods and transfer the heat, while the second uses graphite as a moderator but employs liquid sodium as a heat transfer medium. The main advantage of these reactors over the gas-cooled type is that they would have lower initial uranium investment and slightly lower capital costs. It is possible that these designs may replace gas-cooled reactors in about twelve years' time. Other work is concentrated on fast reactors of the type being built at Dounreay but this is a long-term experiment. From information available, however, it would seem that the whole nuclear power programme could be speeded up considerably.

HEAT TRANSFER

The limitation on the rate of energy release in a nuclear reactor is largely one of heat transfer and to achieve larger reactors than those at present planned much research and development work has to be done on suitable transfer media, on the pipework materials used to convey them, and on the manner in which the cooling material can best circulate among the components of the core. Although gas cooling has been adopted for our early power-producing reactors where natural uranium fuel is being employed, this involves very large pumping powers and liquid coolants such as water or liquid metals can have heat transfer coefficients exceeding that of gas by more than 100 times. Clearly this is a very worthwhile gain and after development has taken place we may expect considerable saving in the size of the heat transfer system.

Many problems yet remain to be solved, however, and an article in this issue by Mr. H. A. Roberts helps in the understanding of how complicated the subject is and what some of the lines of approach to the subject must be. Particularly important is the maintenance of a stable flow, as element failure or burn-out can occur locally if a disturbance in the flow leads to even a local reduction in the rate of heat transfer from a very highly rated and physically small core.

LOSSES AND SUBSIDIES

After their interview with the Prime Minister last week the chairmen of the British Transport Commission, the North of Scotland Hydro-Electric Board and the Gas Council decided to follow the Central Electricity Authority and the National Coal Board in "pegging" their charges. Their hope is that this "gesture" will have some effect in restraining their employees from pressing claims for higher wages. Indeed, if they are unsuccessful in this they will all find themselves incurring deficits; it is unlikely that improvements in productive and administrative efficiency will be great enough to prevent it. Already the railways are heavily in debt and it has been hinted that the Labour Party favours their subsidisation by the Government "for a limited period." If deficits of nationalised industries are to be met in this way what incentive will those industries have to work out their own salvation? And of what ultimate advantage will it be to the country if it has to make up losses anyway?

PORTABLE ELECTRIC TOOLS

All industries and the home handyman are now making extensive use of portable electric tools and a very wide selection of equipment is available to cater for the specific requirements of all types of users. International requirements with regard to these tools differ widely and while certain countries impose no regulations at all others call for precautions which are unnecessarily severe and almost impossible to take. If these divergencies can be overcome, another barrier to international trade will be removed and the resultant standardisation of equipment will be most beneficial to the user both in performance and ultimate cost.

In an endeavour to bring about this standardisation the Federation of European Electric Tool Manufacturers' Associations held a conference in London last week and apart from the leading British electric tool manufacturers, representatives from twelve Continental firms attended. Another topic discussed at the conference was that of safety. Because of their simple construction and ease of operation such tools are frequently subjected to severe overloading and harsh treatment and receive little or no maintenance. Although in the majority of cases portable electric tools are capable of withstanding such abuse, accidents do occur, and in almost every case they can be traced to lack of care on the part of the user.

FOOD MIXERS

The next in our series of illustrated surveys of domestic electrical equipment (13th July) will deal with electric food mixers. Particulars to be given in tabular form will include details of capacity, standard equipment, special features, finish, accessories, price, purchase tax, etc. On 3rd August hair dryers will be dealt with

HEAT TRANSFER

SOME PROBLEMS IN CONNECTION WITH NUCLEAR REACTORS AND CONVENTIONAL POWER STATION STEAM GENERATION

By H. A. ROBERTS, B.Sc.(Eng.)*

A NOTABLE advance in the history of steam generation is the development and operation of an experimental nuclear reactor capable of producing steam from the core for the power cycle. Such a reactor, described in a paper by Dietrich, Lichtenberg and Zinn[1] at the Geneva Conference on Atomic Energy for Peaceful Purposes, was built to determine how stable and safe a boiling reactor would be. The uncertainties in moderation resulting from steam formation in the core and the statistical variations in bubble population may introduce severe fluctuations in reactivity and consequently power output. This reactor was of course of simple construction and low power output, but a short description here will serve as a model for the following discussion of the heat transfer processes.

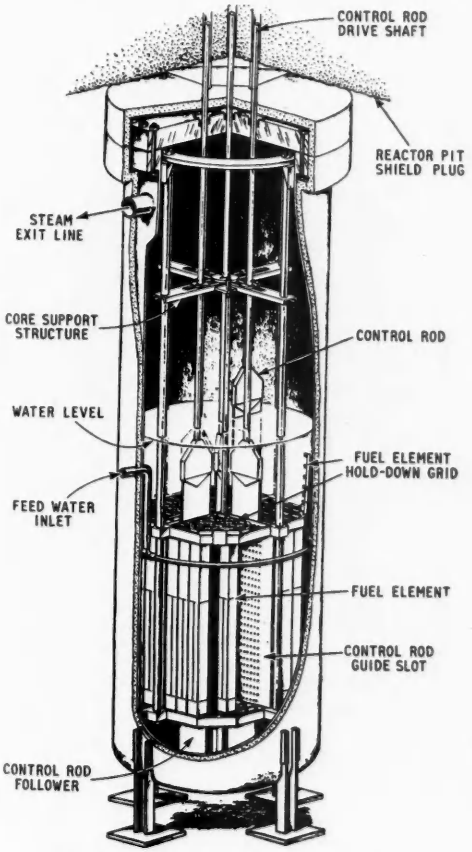


Fig. 1.—Core assembly in a reactor vessel

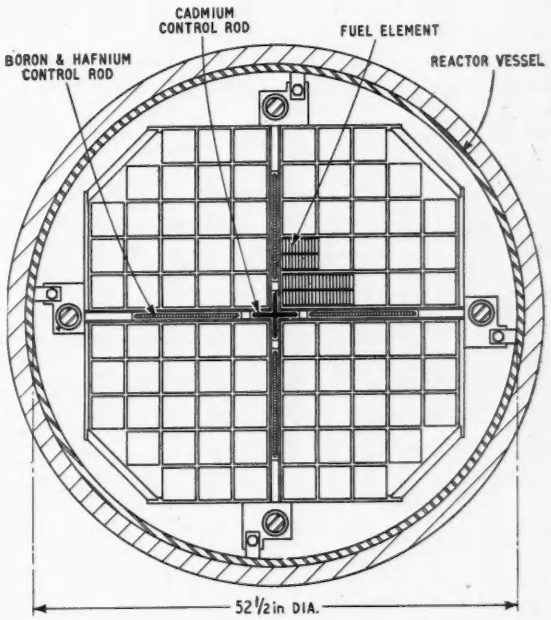


Fig. 2.—Cross-section through reactor core

Fig. 1 shows the reactor, which consists of a core with an extension in the form of a cylindrical chimney providing the natural circulation head driving the moderator and coolant. The production of steam expands the moderator so that the liquid level is above the top of the chimney. Steam is drawn off to a separator and subsequently through the power cycle while water returns to the base of the core and the cycle is repeated. At some convenient point in the down-comer the condensate is introduced and mixed with the water from which the steam has been stripped. The mixing reduces the temperature of the water so that at entry to the core, the temperature is well below saturation; thus a relatively high moderator density is maintained in the reactor by confining steam production to a certain proportion of the core volume.

Nevertheless a considerable change is effected in the distribution of heat flux along the length of the reactor, which for a non-boiling cylindrical core has approximately a sinusoidal form, the point of maximum flux being at the centre, but which is now distorted by the increased neutron leakage in areas of low moderator density so that the point of maximum heat flux is nearer the base, the amount of distortion depending on the amount by which steam production reduces the moderator density in the upper part of the core. One of the main advantages of this system is the high degree of safety inherent in the nature of steam production, a surge of reactor power being controlled by a reduction in moderator density.

The core of this reactor is made up in sectional units with plates of fissile material suitably contained and arranged as shown in Fig. 2. These units are stacked on a raft to form the reactor core and water flows by natural circulation upwards through the spaces between elements.

* Atomic Energy Research Establishment, Harwell.

List of Symbols and Abbreviations

Symbols

a	Laplace's constant in equation 2 and a constant in equation 14.
A	Area.
C_p	Specific heat at constant pressure.
D	Diameter.
D_E	Equivalent diameter.
D_b	Bubble diameter at instant of leaving a surface.
f	Farming friction factor.
G	Mass flow rate for unit area.
g	Gravitational constant.
h	Heat transfer coefficient.
h_b	Boiling heat transfer coefficient.
H	Length of channel.
k	Thermal conductivity; slip ratio.
k_I & k_E	Inlet and unit loss coefficients.
L, l	Length.
n	Rate of single bubble production.
Nu	Nusselt number.
Nu_b	Bubble Nusselt number.
P	Perimeter of channel and heater.
Pr	Prandtl number.
p	Pressure.
$\triangle P$	Pressure difference.
q/A	Heat flux density.
q	Quality.
R	Expansion ratio.
r	Multiplier in equation 10.
Re	Reynolds number.
Re_b	Bubble Reynolds number.
T	Temperature.
$\triangle T$	Temperature difference.
T_s	Saturation temperature.
$\triangle T_s$	Surface temperature — saturation temperature.
$\triangle T_{sub}$	Saturation temperature — bulk liquid temperature.
V	Velocity.
v	Specific volume.
W	Mass flow.
Z	Static head.

Suffixes

b	Boiling.
cr	Critical.
E	Equivalent.
f	Friction.
l	Liquid.
m	Mean.
s	Static.
s	Saturation.
s	Steam.
v	Vapour.
w	Water.

Greek Symbols

α	Acceleration pressure drop coefficient.
β	Angle of constant of bubble with surface.
φ	$= K\frac{\rho v}{\rho l}$
λ	Latent heat of vaporisation.
μ	Dynamic viscosity.
υ	Kinematic viscosity.
ρ	Density.
ρ	Mean density of steam-water mixture at any section.
σ	Surface tension.

The pattern of flow and mode of heat transfer in these passages is quite varied. Water enters the base of the reactor with some considerable sub-cooling (that is, it requires sensible heat before saturation temperature is reached) and the heat flux being relatively low, no boiling takes place. As the water rises by the action of natural circulation, it gains heat from the plate elements and approaches saturation temperature. At some point where the water is still below the saturation value, surface boiling begins, bubbles being formed and collapsing on the surface; as the temperature is increased further the bubbles leave the surface and collapse in the main stream. At, or near saturation temperature, at some distance from the base of the reactor, steam formation begins and bubbles formed on the surfaces proceed independently to the free surface. Hereafter the rate of steam production is dependent on the surface heat rating encountered. This type of boiling is known as nucleate boiling, but may also be called saturated, bulk, pool, or total boiling. The mode of boiling previously described as surface boiling is also called local, sub-cooled or incipient boiling.

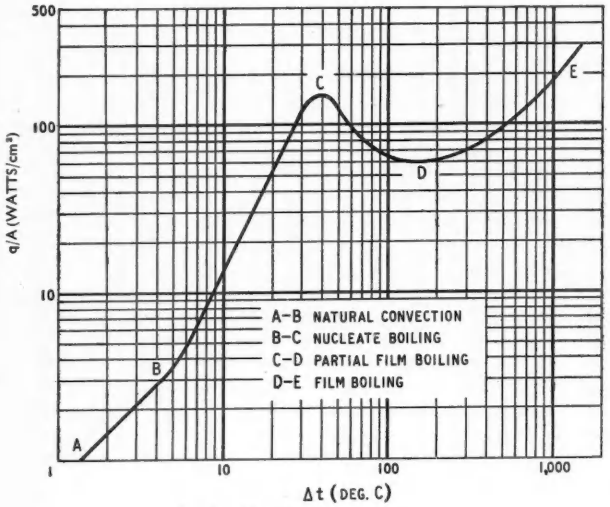


Fig. 3.—Heat transfer curve

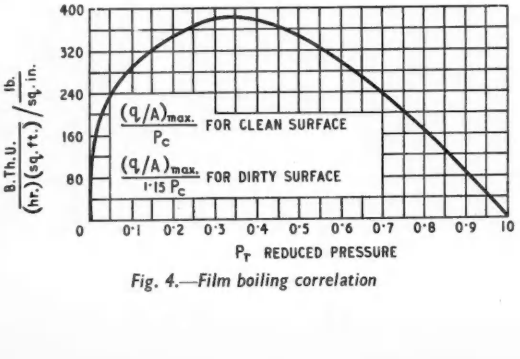


Fig. 4.—Film boiling correlation

From these two distinct forms of boiling a third mode may arise, resulting from too high a surface heat rating. Bubble production on the surface becomes so great that a blanket of steam is formed over part of the element, successfully insulating that part of the surface and decreasing the heat transfer rate to that obtainable across a steam film. For self-heating reactor elements, the resulting temperature rise is sudden, and in general catastrophic failure occurs by melting of the surface material.

Fig. 3 shows a plot of heat surface rating q/A in watts/sq cm against surface temperature minus saturation temperature, $\triangle T_s$ for pool boiling, according to Nukiyana's data.

While heat is passed to the water originally at saturation temperature, at first no boiling occurs but the temperature of the water rises above saturation, becoming superheated, and the heat transfer process is by natural convection. At B bubbles begin to form and an increased rate of heat transfer is noted as the surface temperature is raised towards C. Here the bubbles begin coalescing on the surface and the heat flux decreases with increasing surface temperature because of the formation of a stable vapour film at D. The curve then passes through a lower critical point at which stage the surface temperature reaches a value where heat transfer by radiation becomes significant.

At a higher surface temperature the surface rating increases towards E. Point C gives the maximum or critical heat flux and the corresponding surface temperature minus saturation temperature, the critical temperature difference. Self-heating elements subjected to critical surface heat ratings induce stable film boiling conditions appropriate to the applied heat flux, corresponding to point E on Fig. 3. If the element survives and the heat flux is lowered, bubble boiling is restored via the lower critical heat flux.

A comparison with conventional power station steam generation equipment of similar output would indicate the vast difference in size between the steam generator sections of both types of plant. Whereas mean surface heat fluxes are only slightly lower in the water-tube natural circulation boiler than in the reactor, there is a great discrepancy in volume, the boiler being many times larger. Coupled with this the boiler is not troubled by the strict density control required in boiling reactors and may start evaporation at any point in the upcomer, depending only on the circulation characteristics of the system. Further

the actual process of heat transfer is somewhat different, for whereas the nuclear reactor transfers energy from the reacting fissile material directly to the liquid, the boiler relies on gas transfer between the gaseous products of combustion to water tubes by radiation and convection. The latter process is then limited by the rate of heat transmission on the gas side.

Nevertheless the problems of failure which preoccupy the nuclear reactor designer are also of some concern in connection with boiler plant design, although in the latter case the lower surface heat rating possible is, except where complete evaporation instability occurs, a natural safety factor. The general trend in power plant is to increase system pressure which, as will be shown later, tends to reduce burn-out heat flux by transition to film type boiling for pressures over 1,000 lb/sq in. For very high pressures, therefore, some account must be taken of criteria of failure, so that the minimum safe total heat transfer area may be calculated.

It becomes necessary to examine closely the mechanism of failure of elements in the boiling water reactor and to arrange a reasonable factor of safety based on the highest value of surface heat flux anticipated. For a given core volume and power output the surface heat flux may be reduced by increasing the surface area, and hence friction losses, to a point where natural circulation alone will not provide the required flow rate. It becomes rather important, because of the high pressure drops which are generated, to increase the surface area no more than is strictly required as an insurance against element failure, and hence to know as accurately as possible the conditions under which a failure may take place.

Element failure or burn-out may take place in several ways: if the liquid film and eddy conductivity is insufficient to restrict the surface temperature; if there is a sudden increase in temperature to a value exceeding that at which failure takes place, by the onset of film boiling; if instability of flow leading to failure by vapour locking takes place; if, the sonic rate of flow being reached in a channel, an increase in heating rate cannot further increase the flow rate in a natural circulation system; or if complete evaporation of the tube or channel contents occurs.

Insufficient Liquid Film and Eddy Conductivity

Heat transfer coefficients for non-boiling liquids are well known for a large number of configurations, but when boiling is instigated the situation is changed, an additional number of variables being introduced, and the prediction of surface temperatures becomes uncertain at best. The flow of heat is complicated by the presence of the second phase which, while the vapour may not be directly responsible for a large proportion of the heat transport from the surface, may cause a high degree of turbulence in the surface film and in the body of the liquid by bubble motion.

The formation and release or collapse of bubbles is of great interest here in determining the factors affecting heat transfer by boiling[2, 3]. Many experiments in which bubbles are photographed in various stages of formation, and calculations on idealised bubble shapes, lead to the following picture:—At first heat from the surface raises the temperature of the liquid and develops a temperature field throughout, depending on the thermal and eddy conductivity of the liquid. If turbulent flow in a pipe prevails, then a large proportion of the total temperature

TABLE 1

BOILING—HEAT TRANSFER

Authors	Variables	Geometry and materials, surface conditions, etc.	Correlation
McAdams, Addoms, Kennel	Pressure range 30–90 lb/sq in abs Velocity range 1–36 ft/sec Sub-cooling 20–150 deg F	Surface boiling. Stainless steel system with stainless steel electrically heated element, being a thin walled tube centrally placed in an outer tube. Water flows in the annulus thus formed. The water is distilled and degassed to various degrees of air content.	$\frac{q}{A} = C^1 \triangle t_{sat}\ 3{\cdot}86$ B.Th.U/sq ft/hr water air content cc/litre: C^1 0·30: 0·189 0·06: 0·074 The transition from non-boiling to surface boiling is given by $t_{sat,\,tr} = \left[\frac{0{\cdot}026}{C^1}\frac{\triangle t_{tr}}{D_E}\left(\frac{DEG}{\mu}\right)^{0{\cdot}8}\left(\frac{Cp\mu}{K}\right)^{\frac{1}{3}}\left(\frac{\mu}{\mu_w}\right)^{0{\cdot}14}\right]^{0{\cdot}259}$
Rohsenow	Data of Cichelli and Bonilla Addoms Cryder and Finalborgo	Pool boiling of varying organic fluids.	$\frac{Cp}{\lambda}\triangle T_s = Csf\left(\frac{q/A}{\mu\lambda}\sqrt{\frac{\sigma}{\rho e - \rho v}}\right)^{0{\cdot}33}\left(\frac{Cp\mu}{K}\right)^{1{\cdot}7}$ *Materials* — *Csf* Ethyl Alcohol — chromium 0·0027 Cichelli Bonilla Platinum wire — water 0·013 Addoms Chromium — Benzene 0·010 Cichelli Bonilla Chromium — n Pentane 0·015 Cichelli Bonilla Brass tube — water 0·0060 Cryder Finalborgo
Jens and Lottes	Pressure range 85–2,000 Velocity 3–40 ft/sec Sub-cooling 5–200 deg F	Surface boiling. Degassed distilled water on nickel and stainless steel.	$\triangle T_s = \frac{60\left(\frac{q/A}{10^6}\right)^{\frac{1}{4}}}{e^{p/900}}$ deg F.
McNelly	Data of Insinger and Bliss Pool boiling of organic fluid	Pool boiling of organic fluids.	$\frac{hbD}{k} = 0{\cdot}0225\left(\frac{Cp\mu}{k}\right)^{0{\cdot}69}\left(\frac{\rho v}{\rho_L} - 1\right)^{0{\cdot}33}\left(\frac{q/AD}{\lambda\mu}\right)^{0{\cdot}69}\left(\frac{pD}{\sigma}\right)^{0{\cdot}31}$
Sterman	Pressure 2 atmospheres Velocities 0–20 ft/sec	Pool boiling of water in a vertical tube.	$\frac{Nu_b}{Nu} = \left(\frac{16{\cdot}4\ q/\lambda\rho s}{V_a}\right)^{0{\cdot}7}$
Bogdanov	Pressure 600–1,500 lb/sq in abs. Velocity 0–15 ft sec	Nucleate boiling in an inclined evaporator tube	$Nu_b = 0{\cdot}125\ Re_b^{\ 0{\cdot}7} Pr^{0{\cdot}35}\left(\frac{p}{p_1}\right)^{0{\cdot}79}\left(\frac{V}{V_1}\right)^{0{\cdot}1}$

drop occurs across a surface laminar film where eddy conductivity plays a very minor part. With the bulk of the water at the saturation temperature, a high degree of superheat may be generated at the wall as the heat flux is raised. Bubbles then form as a result of breakdown of the superheated liquid the radius of formation resulting from an applied pressure difference being given by Kelvin's equation which defines the pressure differences required to maintain a surface of separation radius r,

$$p_r - p = \frac{2\sigma}{r} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Here p is the system pressure, p_r the pressure at the outside surface of the bubble and σ the surface tension.

In pure liquids bubbles would seem to require a high pressure difference and consequently a high superheat to develop a surface of separation of extremely small radius as an embryonic bubble would be. But in most cases of industrial steam generators, small particles, gas bubbles and irregularities on the surface play an important role in restricting superheat, by providing nuclei on which steam bubbles may form. Thus surface conditions are extremely important here, variations in composition, roughness and scaling inducing differing rates of bubble formation.

Of interest in the nuclear reactor field is the effect of high energy radiation on the liquid superheat level. It has been noted that ionisation in the water causes a breakdown of superheat and indeed lines of research are in progress on bubble chambers, vessels containing liquids at high values of superheat, for detecting cosmic rays and other nuclear reactions. A charged particle passing through the liquid leaves behind clusters of ionised liquid molecules whose electrostatic charges in some way overcome the surface tension forces. Clearly this effect is important in a liquid boiling in the intense gamma and neutron fields prevailing in reactor cores.

After formation, the bubble grows rapidly as heat is supplied from the superheated liquid, until a critical size is reached where acceleration and buoyancy forces exceed the surface tension forces. The bubble is then discharged from the surface with some velocity in an initial direction normal to the wall. This critical diameter D_b of a spherical bubble is given by:

$$D_b = C_1 \sqrt{\frac{\sigma}{\rho_w - \rho_s}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where C_1 is a constant, σ surface tension, ρ_w density of water and ρ_s density of steam.

The cavity left by the bubble is filled by a jet of cooler water from the main stream, in the case of a flowing liquid in a tube, and a second bubble is instigated from particles of vapour remaining from the first. Thus steam bubbles form at preferred points on the heated surface and increase in heat flux does not affect the rate at which bubbles are discharged from a point but merely increases the number of centres of bubble formation. A relationship between the bubble diameter, the frequency of discharge from a point, and appropriate liquid and system variables has been deduced by Zisina, Molozhen and Kutateladze and is given by:

$$D_b n = C_2 \sqrt{\frac{g\,\sigma\,\rho_w}{p\,\rho_s}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where p is the system pressure and C_2 is a constant.

In the case of surface boiling an appropriate modification to the above model is that the bubble reaches a different critical size and collapses, this critical bubble dimension here depending on the degree of sub-cooling of the bulk of the liquid.

Experimental work has been in the main directed towards obtaining relationships between heat transfer coefficients and the system variables and in Table I there are listed some of the more notable correlations resulting from this experimental work. Data on the effect of surface variables is scarce and what exists is inconclusive.

TABLE 2

CRITICAL HEAT FLUX CORRELATIONS

Author	Variables	Data
McAdams	Degassed distilled water in annuli Velocity 1–36 ft/sec Pressure 30–90 lb/sq in abs. $\triangle T_{sub}$ 20–100 deg F at exit	$\left(\frac{q}{A}\right)_{BO} = (900{,}000 + 4{,}800\ \triangle T_{sub})V^{\frac{1}{4}}$ B.Th.U/sq ft/hr
Gunther	Degassed distilled water Velocity 5–40 ft/sec Pressure 14–160 lb/sq in abs. $\triangle T_{sub}$ 20–280 deg. F at exit	$\left(\frac{q}{A}\right)_{BO} = 7{,}000\ V^{\frac{1}{4}}\ \triangle T_{sub}$ B.Th.U/sq ft/hr
Buchberg	Degassed distilled water Velocity 5–30 ft/sec Pressure 500–2,000 lb/sq in abs. $\triangle T_{sub}$ 3–160 deg F at exit	$\left(\frac{q}{A}\right)_{BO} = 520\ G^{\frac{1}{4}}\ \triangle T_{sub}^{0.2}$ B.Th.U/sq ft/hr
Jens and Lottes	Degassed distilled water Mass flow rate $0{\cdot}2 - 7{\cdot}71 \times 10^{-6}$ lb/sq ft/hr Pressure 300–2,000 lb/sq in abs. $\triangle T_{sub}$ 5–150 deg F at exit Round and square tubes L/D 21 to 110	$\left(\frac{q}{A}\right)_{BO} = C\left(\frac{G}{10^6}\right)^m\ \triangle T_{sub}^{0.22}$ B.Th.U/sq ft/hr p-lb/sq in: 500, 1,000, 2,000 m: 0·16, 0·28, 0·50 C: 0·817, 0·626, 0·445
Sterman	Pool boiling Various liquids	$\frac{\left(\frac{q}{A}\right)_{cr}}{\lambda\,(q\rho v)^{\frac{1}{4}}\,[a\,(\rho L - \rho_v)]^{\frac{1}{4}}} = \text{const.}$
Rohsenow	Pool boiling Various liquids	$\frac{(q/A)_{cr}}{\rho r \lambda} = \frac{14{\cdot}3\,(\rho L - \rho v)^{0.6}}{\rho e}$
Deissler	Degassed distilled water in pipes and annuli	$\frac{(q/A)\,\mu\rho L}{\lambda G \rho} = 0{\cdot}08\left[\frac{\rho}{\rho_v}\cdot\frac{D_6}{L}\right]^{0.67}$

Failure by Transition to Film Boiling

Carrying the bubble picture further: by increasing the heat flux the centres of bubble production increase so that the surface becomes covered in bubbles in varying forms of growth at any given instant. Considerable interference may be present in the existing bubble population in the fluid stream and the velocity of the liquid also has a modifying effect on the bubble concentration near the surface. Groups of bubbles may now coalesce and blanket the surface for a short time until buoyancy and circulation forces remove the vapour film. But at yet higher surface ratings the film becomes widespread and rapid increase in surface temperature occurs.

The dependence of the critical heat flux on the variables affecting nucleation is now quite obvious since the blanketing of the surface must occur at a critical volume flow of steam from the surface.

Many early experiments on this part of the work were carried out under pool boiling conditions. Cichelli and Bonilla's[4, 5] correlation of their experimental results was in the form of a plot of critical heat flux divided by the

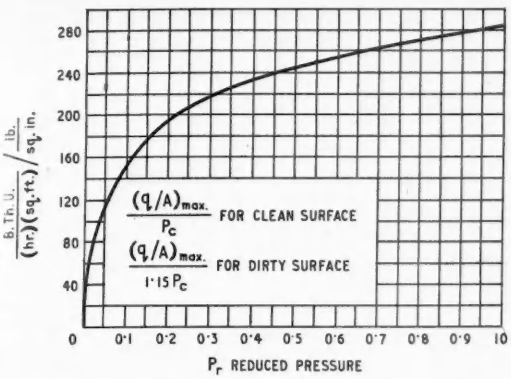


Fig. 5.—Correlation of maximum boiling rate in region

critical pressure against system pressure divided by critical pressure. Figs. 4 and 5 show this correlation. Fig. 6 shows further data on pool boiling of water by Kazakova and natural circulation work by Lukomskii indicating the general trend of results. The critical heat flux rises to a peak at about 1,000 lb/sq in, corresponding to one-third of the critical pressure.

Table II gives further data on the present state of knowledge regarding critical heat flux.

Instability of Flow[6, 7]

It is well known that failure or burn-out occurs at a much lower value under unstable flow conditions. Not much is known physically about this process and it will be sufficient here to describe how unstable flow may be predicted. This condition apart from leading to burn-out, is an embarrassment in a reactor for many other reasons relating to moderator stability.

The various forms of unstable flow arise from the many modes of flow which derive from a given header to header pressure drop. This overall pressure drop is a summation of the frictional, acceleration, and static losses in the channel, or

$$\triangle p_T = \triangle p_f + \triangle p_a + \triangle p_s \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Included in the frictional losses are those at entry and exit, over the non-boiling, surface boiling, and nucleate boiling lengths. Relating inlet and exit losses as multiples of the entry velocity head the total frictional component may be summed as follows:—

$$\triangle p_T = \triangle p_{f(NB)} + \triangle p_{f(SB)} + \triangle p_{f(B)} + \alpha \frac{G^2}{2g_{fw}} + \rho_m H + \frac{k_I G^2}{\rho_w g} + \frac{k_E R G^2}{\rho_w g} \quad \ldots\ldots\ldots\ldots\ldots (5)$$

where k_I and k_E are inlet and exit loss coefficients, H is the vertical height of channel, ρ_m is the mean overall fluid density, α is the acceleration loss coefficient, R is the expansion ratio and suffixes NB, SB and B denote non-boiling, surface boiling, and nucleate boiling respectively. Non-boiling pressure drops are well known and can be related by

$$\triangle p_{f(NB)} = \frac{2fLG^2}{\rho g D_E} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

and f is given reasonably accurately by

$$f = \frac{·046}{R_e^{0·2}} \quad (11) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

where R_e is the Reynolds number.

Reynolds[8] gives surface boiling pressure drops in the form

$$\triangle p_{(SB)} = \triangle p_{(NB)} \times \left(\frac{\triangle p_{(SB)}}{\triangle p_{(NB)}}\right) \quad \ldots\ldots\ldots\ldots\ldots (8)$$

where the factor $\left(\frac{\triangle p_{(SB)}}{\triangle p_{(NB)}}\right)$ is determined empirically.

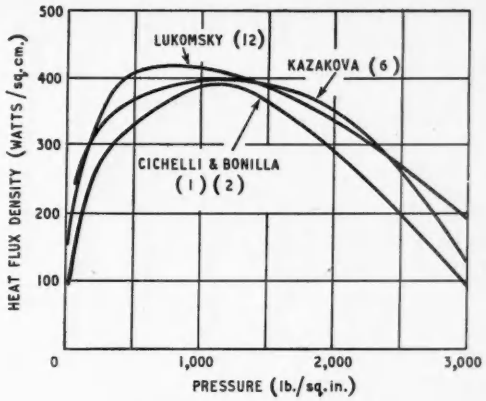


Fig. 6.—Critical heat flux data

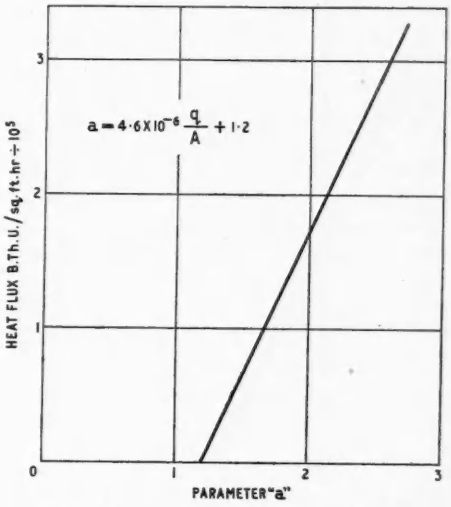


Fig. 7.—Variation of parameter " a " with heat flux

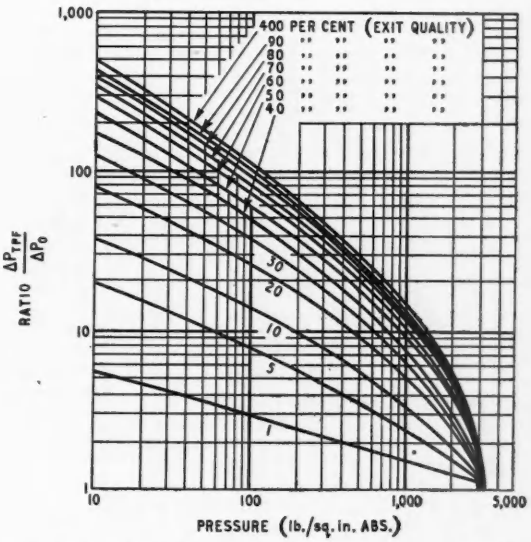


Fig. 8.—The ratio P_{TPF}/P_o as a function of exit quality and absolute pressure

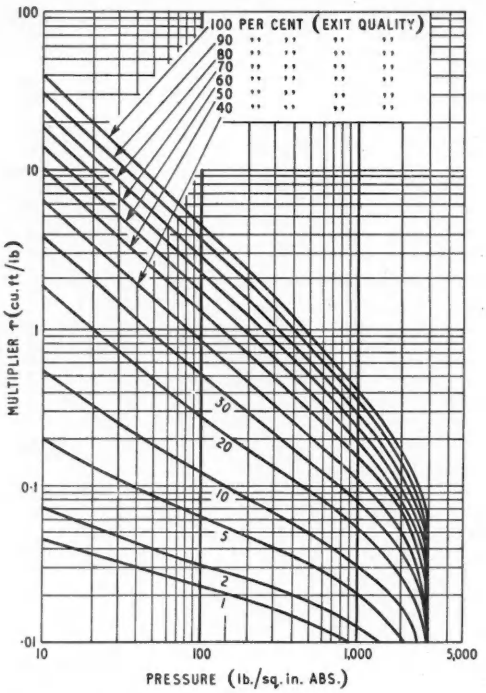


Fig. 9.—Multiplier " r " versus absolute pressure for various exit qualities

The final equation gives

$$\triangle p_{SB} = \left(\frac{dp}{dG}\right)_{(NB)} \frac{GDC_p(\triangle T_s)_o}{\triangle a\, q/A} \sinh\left[\frac{4z.q/A.L}{GDC_p(\triangle T_s)_o}\right] \ldots (9)$$

$$= L = I - \frac{(\triangle T \sinh)_L}{(\triangle T \sinh)_o}$$

G is the mass flow per unit area,

C_p is the specific heat,

$\triangle T_s$ the sub-cooling at the onset of surface boiling,

q/A the mean heat flux,

a given in figure 7,

$(\triangle T_s)_L$ is the sub-cooling at the point where the pressure gradient is being determined, and

$(\triangle T_s)_o$ is the sub-cooling at point where surface boiling starts.

In these two sections acceleration effects are negligible and static head losses may be calculated from the mean density of water and the height through which the water is raised.

The solution to the two phase pressure drop is rather more difficult. The Martinelli solution[9] is perhaps the most flexible but it must be used with caution when applied to vertical tubes. Here

$$\triangle p = \triangle p_{NB} \times \left(\frac{\triangle p_B}{\triangle p_{NB}}\right) + \frac{r G^2}{g} \quad \ldots\ldots\ldots\ldots (10)$$

the latter term being the acceleration component.

$\frac{\triangle p_B}{\triangle p_{NB}}$ and r are each given by the family of curves in Figs. 8 and 9 respectively.

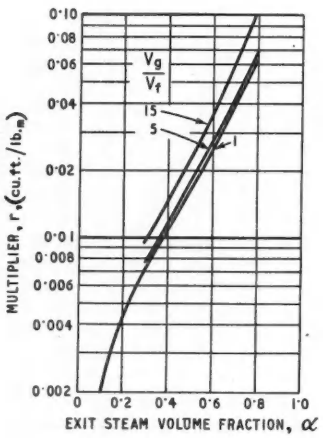
Calculation of the static losses involves the estimation of the mean density of a column of liquid. The difficulty here is that varying rates of steam velocity and residual liquid superheat result from different conditions of flow, and knowledge is empirical in nature. It is convenient to relate bubble slip in terms of the slip ratio $\frac{V_s}{V_w}$ the ratio of steam velocity to water velocity, and some of the existing data by Behringer is given on Fig. 10.

Density relationships may then be expressed in terms of slip quality and the densities of water and steam.

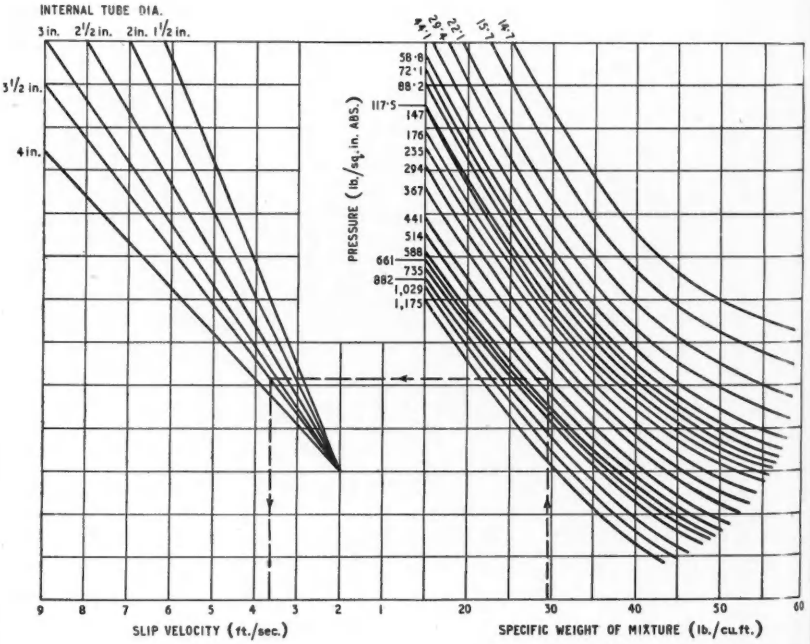
The density ρ at any point is given by

$$\frac{1}{\rho} = q\,\frac{(V_s - KV_w) + KV_w}{K - q\,(k - 1)} \quad \ldots\ldots\ldots\ldots\ldots (11)$$

where K = slip ratio = V_s/V_w



Above: Boiling studies at the Argonne, relating to boiling reactors



Right: Fig. 10.—A plot of Behringer results

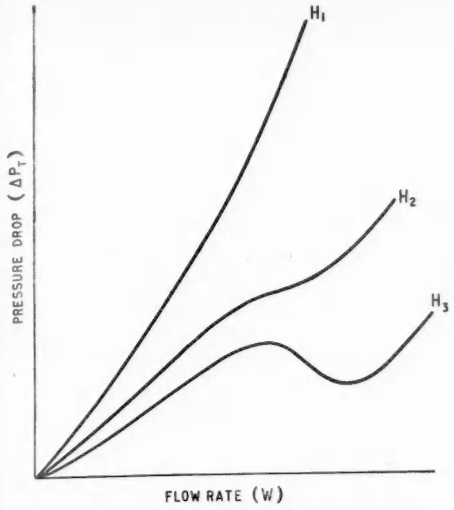


Fig. 11.—Instability in single channels

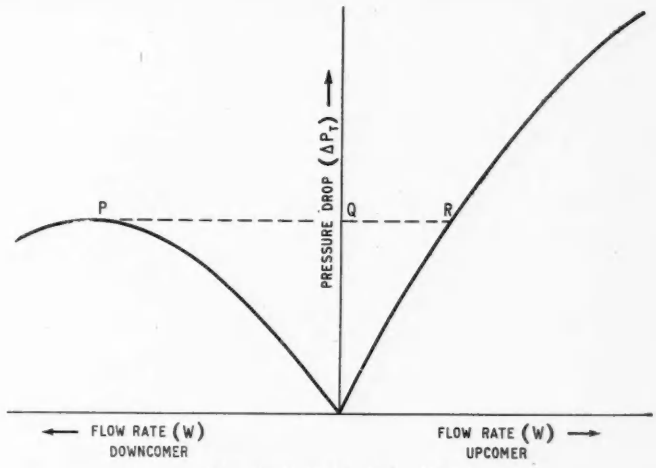


Fig. 12.—Instability in parallel channels

and the mean density ρ_m over a given length l may be estimated from

$$\rho_m = \int_0^e \frac{1}{\rho}\, dl \qquad \ldots\ldots(12)$$

From these data total pressure drop may be estimated for varying values of flow and a graph showing the variation of pressure drop with flow constructed for a single tube. At a particular combination of circumstances involving the degree of sub-cooling at entry and the heat production in the tube the situation depicted by Fig. 11 arises. Here it may be seen that at a particular flow small disturbances in pressure drop may give rise to large variation in flow rate and consequently the flow between certain values may be deemed unstable.

Another form of instability is that which occurs where many channels in parallel operate between the same header but have different heating rates. The likelihood of flow reversal depends on the sense of the pressure drops in equation 5.

The positive sign refers to upward flow and the negative sign to downward flow. This assessment may be made by plotting a diagram similar to that shown on Fig. 12.

Sonic Velocity in Water-Steam Mixtures

It is well known that a fluid cannot emerge from a tube at a speed higher than the speed of sound, but it is perhaps not so well known that the speed of sound in a mixture of vapour and water is surprisingly low.

Assuming Boyle's law to obtain for the vapour phase, the sonic velocity c in a mixture of steam and water may be given by

$$c = \left\{ \frac{1}{\alpha(1-\alpha)} \frac{p}{\rho_w} \right\}^{\frac{1}{2}} \qquad \ldots\ldots(13)$$

where α is the proportion of the vapour phase by volume. Sonic velocity is always a minimum when $\alpha = \frac{1}{2}$ and this value for water at atmospheric pressure is in the region of 65 ft/sec.

Total Evaporation

So long as a film of liquid remains on the heated walls of a tube, burn-out heat flux has a high value depending on pressure, and circumstances as described earlier. The danger of failure arises when the film disappears by disintegration into the main stream. Here again there is no consistent theory to follow but there is experimental evidence to indicate that failure by this mode occurs at high pressures (500-2,000 lb/sq in) in the region of 80 per cent quality, but this is very strongly dependent on velocity as well as exit quality.

In conclusion, some attempt has been made to set out some heat transfer considerations, vital in the design of the boiling reactor, and also extremely important in boiler design. The gaps in the knowledge of boiling processes are obvious and considerable research into the problems is required, before they may be filled. The nature of the problems is such that the variables are numerous and many of them quite new to the heat transfer field. The work is consequently slow and tedious, each step requiring some caution in eliminating dependent variables.

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Nuclear Radiation Hazards

IN accordance with an undertaking given by the Prime Minister last year, the Medical Research Council appointed a committee to review scientific evidence on the medical aspects of nuclear and allied radiations, and a report, "The Hazards to Man of Nuclear and Allied Radiations," prepared by this committee, has been published by H.M. Stationery Office, price 5s 6d net. The committee has a membership of seventeen which includes Sir John Cockcroft, director of the Atomic Energy Research Establishment, Harwell, with Sir Harold Himsworth as chairman. Major aspects of the subjects covered by the report include the nature of radiation and its action on living cells; the genetic effects of radiation; and existing and foreseeable levels of exposure to radiation and assessment of the hazards of exposure to radiation.

Domestic Electrification Pays

Experience in Three Houses

By E. H. W. BANNER, T.D., M.Sc., M.I.E.E., F.Inst.P.*

NOW that the country's generating capacity again exceeds the demand an increase in domestic electrification is in the national interest, as it was in the years before 1939 and before war conditions increased the industrial load with a nearly constant generating capacity.

Some twenty or so years ago the "Point Five" brigade was active. The running charge for a two-part domestic tariff was widely available in towns at 0·5d/kWh and at that figure, with a reasonable fixed charge, it was economic to the householder for all purposes.

In general, householders use electricity for various personal and economic reasons and have little practical concern with national economics; other considerations such as convenience, cleanliness, absence of smoke and smog, etc., are secondary. Relatively few householders operate their houses 100 per cent electrically; most prefer a coal or other solid fuel fire for main room heating which often incorporates water heating and central heating. This helps to reduce the station peak load, which is an advantage. On the other hand it is probable that few people use electricity for lighting only. Two-part tariffs are therefore commonly employed and of course the greater the consumption the lower is the actual net running cost.

It appears likely that, within the lifetime of many, coal will no longer be available for direct burning in a household grate, where much of the heat and all the by-products are wasted. Whether he—or she—likes it or not, most domestic power for lighting, heating, water heating, cooking and small-power drives will be electrical. Solid fuel interests claim much improved results for newly developed grates, but their good results are not always confirmed by independent testing authorities and it is only the effective efficiency at the point of application that matters. Claims dismissing electric heating because there is only 30 per cent maximum thermal efficiency at the power station are so incomplete as to be quite misleading.

As most householders consider the economics almost entirely, any suggestion of load increasing, preferably off-peak, for the common cause of improving the national load factor and the elimination of smog, etc., is not likely to have much effect. Only proof that it is economic to operate electrically is likely to carry weight with the householder who has to pay the bills.

The houses referred to here, three in number, have been heated mainly by high-temperature radiant heaters. Those who decry radiant heating as giving a "warm front and cold back" are confusing their elementary physics, the above condition being caused by a steep temperature gradient, whether the source of heat is electric, coal fire or the sun, the general air temperature being so low that all the effective heat is felt from the high-temperature radiant source.

At first sight the obvious way to increase the domestic load factor is by the use of storage heaters with time-switch or other control for night use. This would need encouragement from the Central Electricity Authority and Area Boards in the form of a cheap night rate, with competition from manufacturing interests to reduce the cost to the consumer, who must first be persuaded that it will be economic. The wider problems of district heating, domestic heat pumps and combined water heating and larder cooling are not considered in this article which is intended to be a practical account of operating these individual houses electrically, with comparative schemes mentioned by the way. The occupants were normally two.

Annual Costs

The author has operated three houses, which have been mainly or wholly electrified, for over twenty-five years, and has available actual figures of consumption and cost. The first house had coal fires and a gas wash-boiler already installed and these were at first retained; electrification was not therefore complete. The results of the first year were published[1] as they were for the second year.[2] They are given in the table, columns 1 and 2 respectively. It will be seen that less coal and more electricity were used in the second year, with little overall difference in cost of running. The reduction of the net running price per kWh with increased use is well shown.

A five-year period gives a better comparison and these results were later published,[3] the fifth year's figures being shown in column 3. For the fourth and fifth years no coal or other solid fuel was used, but as there was a small gas consumption for the wash-boiler there was still not 100 per cent electrification. For the fifth year consumption had increased somewhat, with a higher weekly cost. The gradual increase seems to be fairly general and due to more use being made of the amenities available, whether electrical or otherwise.

House	First			Second	Third	
Year	1929	1930	1933	1935	1937	1955
kWh consumed	3,499	4,626	6,621	5,362	7,403	10,043
kWh charge	0·5d	0·5d	0·5d	0·5d	0·5d	1·1d
Total elec. cost	£12 14 10	£14 13 0	£18 1 3	£14 18 5	£19 0 6	£47 4 11
Coal cost	£3 0 1	£1 0 11	Nil	Nil	Nil	Nil
Gas cost	£0 14 6	£0 8 11	£0 6 2	£0 6 6	Nil	Nil
Total cost	£16 9 5	£16 2 10	£18 7 5	£15 4 11	£19 0 6	£47 4 11
Average cost per week	£0 6 3½	£0 6 2½	£0 6 11½	£0 5 9	£0 7 4	£0 18 3
Net price per kWh ...	0·875d	0·76d	0·655d	0·68d	0·62d	1·13d

After the five-year period the author moved to another house of generally similar size where the only consumption other than electricity was a gas wash-boiler already installed. The consumption figures for two years were published[4] and for the second year at that house are given here in column 4. The slightly reduced consumption was due to a mild winter and longer absences from home. The overall average weekly cost within the range of 5s 9d to 7s is considered economical for the period of 1929-35.

After this period the author moved to another, rather larger, house which required more heating. Figures of consumption for this house have not been published as they commenced only during 1937, shortly before war

* Major Banner is a consultant.

1, 2 *Electrical Review*, 14th March, 1930, and 5th June, 1931.
3, 4 *Electrical Times*, 19th October, 1933, and 26th December, 1935.

conditions required a return to coal and log heating. Consequently only figures for 1937 and 1955 are considered here, columns 5 and 6. This house is claimed to be 101 per cent electric, the extra 1 per cent being accounted for by a street lamp lighting a front bedroom; this does not appear on the electricity bill!

Post-War Increases

The initial running charge was 0·5d/kWh before the war, but after successive increases it is now 1·1d and the C.E.A. claim that the advance is only 30 per cent over the pre-war average figure is misleading. In the present case the 1937 average net price was found to be 0·62d (column 5) and in 1955 it was 1·13d, i.e. nearly double, with no rebate for prompt payment. Considering the unit charge irrespective of the fixed charge then the figures are 0·5d and 1·1d respectively; an increase of 120 per cent. However, both these increases are less than the average increase in most components of the cost of living over the same period, especially for fuels, thus still further favouring electrical operation.

The consumption increased from 6,621 kWh for 1937 to 10,043 kWh in 1955, excluding the war years. This increase of about a third is accounted for by illness and the use of a room as a study, both requiring additional but intermittent heating for varying periods. The cold winter of 1954-55 was also a factor.

However, although the last annual total of £47·5 (column 6) is 2½ times that for 1937, with one-third greater consumption, it corresponds to approximately twice the cost for equal consumption. It is, of course, the ratio of the net prices per kWh of 0·62d and 1·13d for the years concerned.

Normal economy in use is practised by using the stored heat of the cooker, for example, and employing self-contained units such as kettles, milk boiler, toaster, etc., when only a small amount of cooking is required. The daily use of several hot baths would appreciably increase the consumption; the hot water system is, of course, well lagged. The use of radiant fires is also considered to be an economy as the actual air temperature may be lower than that necessary for comfort with only convected heat, or that from central heating radiators, provided that the occupants are within the beam. Lighting is such a relatively small load that no restriction in its use is attempted, the main lounge light source being a 300 W lamp, which is more efficient than three 100 W lamps.

Comparing this with similar-sized houses and requirements using coal and/or coke, etc., it will probably be found little different in total cost. Electricity accounts are readily available for examination, but cash payments for coal, etc., are not always recorded and in many cases the author has been unable to obtain true comparative figures for this reason. Where such figures have been obtained it has been found that the electric house is economic, quite apart from the saving in labour and the elimination of smoke and smog, and in the best utilisation of natural resources—which is where we started.

Claims by Injured Employees

Breaches of Regulations and Negligence

By F. E. SUGDEN

IN a recent case which occupied the attention of the Courts the plaintiff, an electrician employed by the defendants, was instructed to install additional lighting in their premises which were being reconstructed. While walking through a passage between two pieces of equipment, to inspect certain machinery, his foot missed the edge of an open duct about 21 in deep and 18 in wide, and he fell and sustained injuries. He claimed damages from the defendants for breach of common law duty towards him on the grounds that there was no grille or chequer plate over the duct and that the lighting was inadequate. He also alleged that the defendants were in breach of their statutory duty under the Electricity (Factories Act) Special Regulations, 1908 and 1944, regulation 26, in that the part of the premises where the accident occurred was not adequately lighted to prevent danger.

The Judge said that in this case there were more or less two points involved, first, breach of regulations or statute, or Statutory Rules and Orders (now Statutory Instruments) and, secondly, negligence on the part of the employer or part negligence of employer and part negligence of the employee, a matter of common law.

The Court held that there was no breach of duty as regarded regulations, etc., because the regulation which laid down, *inter alia*, that "all those parts of premises in which apparatus is placed shall be adequately lighted to prevent danger" had been observed.

The plaintiff contended that the accident had resulted from a danger within the meaning of the regulation and he further contended that the term "danger" in the regulation meant danger to health, or danger to life or limb from shock, burn or other injury to the person employed or from fire attendant upon the generation, transformation, distribution, or use of electrical energy. The Judge said that these regulations dealt with matters quite apart from the risks from the use of electricity. He also found that there was no valid case at common law and therefore the plaintiff failed in his action for injury against the defendants.

This ruling that there had been no negligence and therefore no liability at common law is important. There are two types of compensation for an employee if he sustains injury arising out of or in the course of his duties. Where there is no negligence on the part of the employer the employee cannot succeed in a claim for damages; he must apply for compensation under National Health Insurance which, unfortunately, is inevitably less than his wages for the period of disability.

Many employees are under a misapprehension for they think that they get the same benefits as they obtained under the old Workmen's Compensation Act. In the past the employer took out an insurance policy to cover the cost of injuries to his staff. Immediately an accident occurred the case was handed over to the insurance company. In such cases the company paid the injured workman so much weekly and eventually offered him a lump sum to settle the claim which might amount to several hundred pounds.

Nowadays the only case in which a lump sum is ever obtained is where the employee claims at common law against his employer and succeeds in proving that his employer or a fellow employee has been negligent.

The Shakespeare Memorial Theatre, Stratford-on-Avon

Sightseeing and Works Tours in the Midlands

AT the invitation of the South Midland Centre, the Summer Meeting of the Institution of Electrical Engineers was held in the Midlands last week with Birmingham as headquarters. About 460 members and guests attended. The first official function was on the evening of 25th June—a reception by the Lord Mayor and Lady Mayoress of Birmingham, Alderman E. W. Apps and Mrs. John Collins, at the Council House, followed by dancing.

On the Tuesday morning there were alternative visits to the Stafford Works and Nelson Research Laboratories of the English Electric Co., Ltd.; the Barlaston Works of Josiah Wedgwood & Co., Ltd.; the factory of the Lotus Shoe Co., Ltd., at Stone; and the telephone and radio training school of the G.P.O.

Considerable expansion of the English Electric Stafford Works has taken place in recent years and building extensions completed in 1949 provided facilities for erecting and testing the very largest generating plant. The present products of the works include steam-turbine and water-turbine driven alternators and d.c. generators.

The Wedgwood Barlaston factory employs some 1,800 persons. Production consists mainly of tableware, both earthenware and fine bone china, of which about one-half is sold in the North American market. Firing is effected entirely by electricity, in three double-tunnel and three single-tunnel continuous kilns, representing the first and largest all-electric tableware installation in the world.

At the Sandon Road, Stafford, shoe factory of the Lotus Shoe Co. a single feeder supplies power from the grid at 6·6 kV to a combined transformer house and substation in the centre of the main works. The transformer house contains four 250 kVA and one 400 kVA 6·6 kV to 400 V English Electric transformers mounted in a line down the centre. There are some high-speed machines for the edge-trimming of soles driven by 170 c/s motors.

About 7,000 trainees from all parts of the British Isles pass through the Post Office Central Training School each year. There are complete director, non-director, and unit automatic exchanges, together with various types of trunk and junction signalling equipment, including apparatus used for setting up long-distance calls by through dialling; and complete audio, carrier, and coaxial systems, the last including equipment capable of carrying up to 1,000 speech channels, or providing two television links, over one pair of coaxial tubes.

The whole party lunched in Stafford as guests of the

G.E.C. heavy engineering works, Witton

English Electric Co. and then most of the members and guests made tours of Shropshire and Worcestershire, stopping for tea at Ludlow as guests of the Midlands Electricity Board. In addition, many members attended an informal dinner at Malvern arranged by the English Electric Co.

There was another series of alternative visits on the following day to the Rugby establishments of the British Thomson-Houston Co., Ltd.; the G.P.O. Transmitting Station at Rugby; the Coventry factory of Courtaulds, Ltd.; and the Coventry Telephone Works of the General Electric Co., Ltd.

Three distinct tours were arranged for visitors to the B.T.H. works to see apprentice training at Coton House; lamp manufacture, and lighting in the home; and the manufacture of heavy electrical plant.

The new Post Office radio station at Rugby, the most advanced of its kind in control and operating technique, was described in the *Electrical Review* of 5th August, 1955.

At the G.E.C. telephone works visitors saw the assembly, wiring and testing of equipment for automatic telephone exchanges, radio and line transmission systems, and remote supervisory control systems.

The Rugby party lunched at Chesford Grange as guests of the British Thomson-Houston Co. and those who took part in the Coventry visits were entertained to luncheon by the General Electric Co.

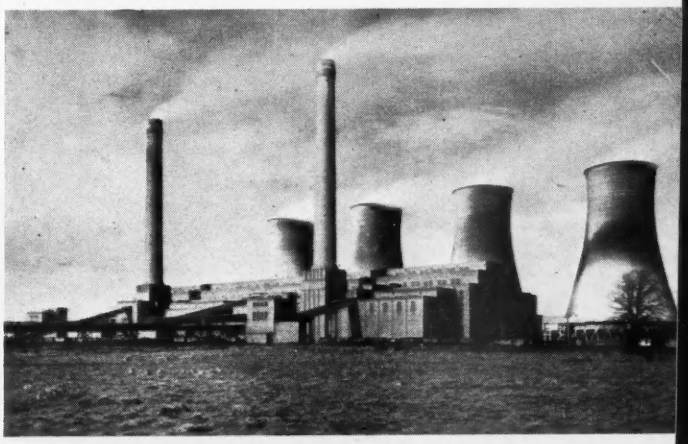
In the afternoon the Rugby and Coventry parties joined forces again to take part in alternative tours which embraced visits to Warwick Castle, Charlecote Manor, Stratford-on-Avon, St. Mary's Church and Lord Leycester's Hospital, Warwick, Kenilworth Castle and Stoneleigh Abbey. These tours all terminated at Stratford where high tea was provided by the East Midlands Division of the Central Electricity Authority and the East Midlands Electricity Board.

In the evening most of the members attended the performance of *The Merchant of Venice* at the Stratford Memorial Theatre as the guests of the British Thomson-Houston Co. This was followed by a buffet supper before the theatre party returned to Birmingham.

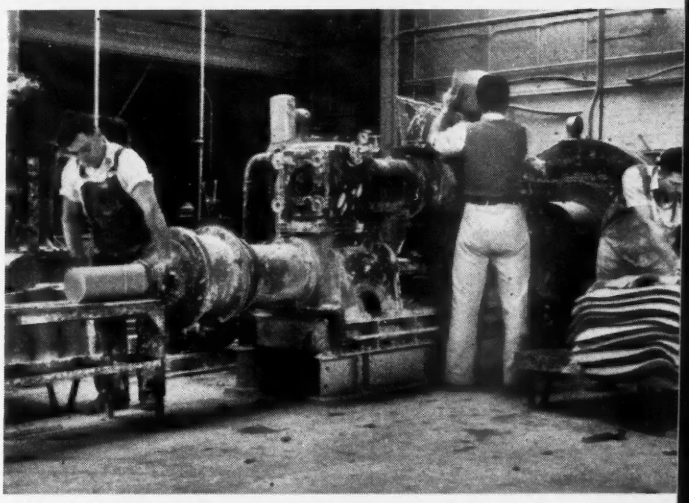
On the Thursday there were alternative morning and afternoon visits in Birmingham as follows: the Witton works and the Newhall Street showrooms of the General Electric Co.; the electrical engineering department of Birmingham University; the Museum of Science and Industry; the B.B.C. sound and television studios; and the factories of Frederick Restall, Ltd., Cadbury Brothers, Ltd., Joseph Lucas, Ltd., George Ellison, Ltd., British Electrical Repairs, Ltd., and the Austin Motor Co.

The G.E.C. Engineering Works group at Witton includes the following departments: heavy engineering, main engineering, switchgear, transformers, rectifiers, motors, foundry, and batteries. The second group comprises the Witton moulded insulation works which is devoted to the production of mouldings in synthetic resins and in bituminous materials. At the heavy engineering works the main erection and test bay is served by two 110 ton cranes, and is equipped for the assembly and testing of the largest turbo- and water-wheel alternators likely to be required for power stations for many years to come.

The Electrical Engineering Department of the University of Birmingham is on the point of moving to a fine new building which it will share with the Mechanical Engineering Department. Apart from the common central block containing a very large lecture theatre and the departmental libraries, the two departments have completely separate wings and the mechanical engineering wing is already fully occupied. The main laboratory section of the electrical

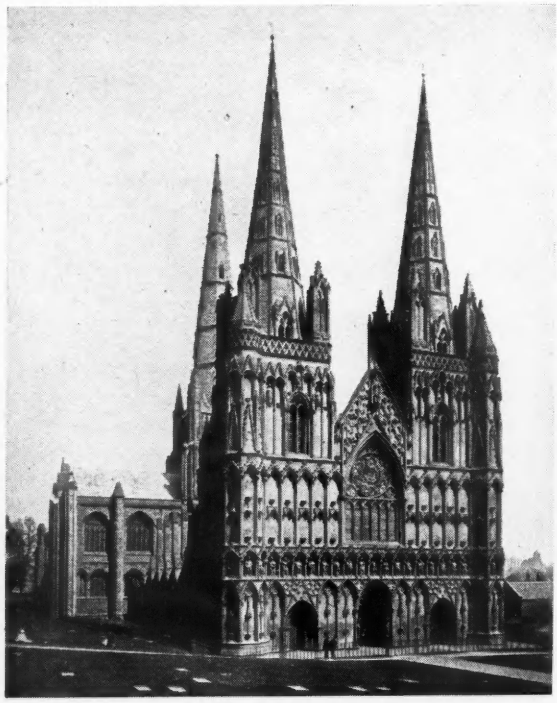


Hams Hall "B" power station

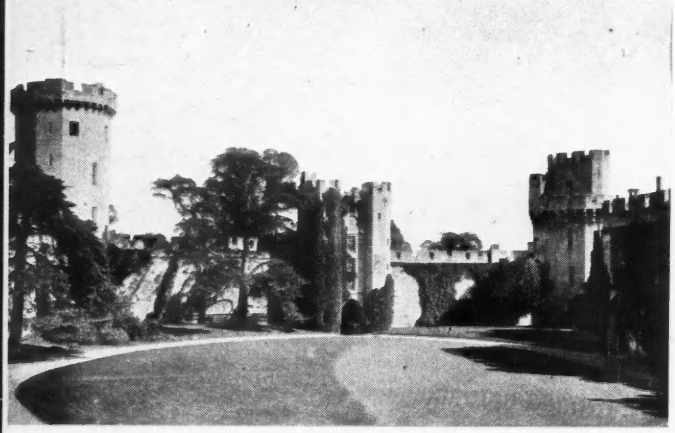


Plugging of a blank for a large insulator at Steatite & Porcelain works

Erecting and testing section for large machines at the English Electric Stafford Works



Lichfield Cathedral has a lofty central and two lesser spires



Other places of historic interest visited included Kenilworth Castle (above) and Warwick Castle (below)

engineering wing will come into use next session and the remainder of the wing containing lecture theatres, lecturers' rooms and some of the research laboratories will be occupied a year or so later. A separate laboratory is now to be provided for automatic control, and in the light current laboratories an enlarged programme of research on communication systems, echo-ranging systems, detection of signals on visual displays, digital techniques, and noise will be carried out.

The Birmingham television studio of the British Broadcasting Corporation at Gosta Green is a converted cinema. It will be equipped at first with three cameras using " Image Orthicon " pick-up tubes, but it is hoped to supplement these at a later date with the new control room now being built.

The B.B.C. television switching centre is the focal point in the Midlands for vision circuits used by the B.B.C. Television Service. Programmes from London are passed through this centre for the Midlands television station at Sutton Coldfield and for B.B.C. television transmitters in the North of England and in Scotland.

At the Frederick Restall works a most interesting and successful development has been the production of end guards for large generators up to 30,000 kVA capacity. These are manufactured from resin-bonded plywood with laminated ash framing.

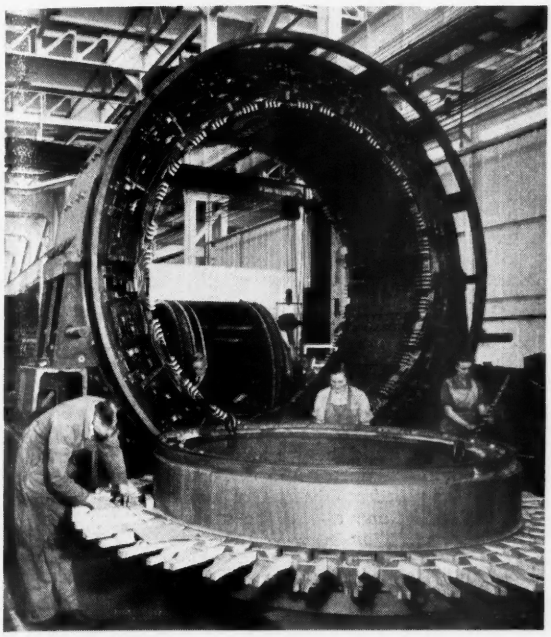
Electric drives in the Cadbury factory employ over 5,000 motors. The majority of these are small but there are 150 h.p. and 300 h.p. auto-synchronous motors in use. There are three large refrigeration stations having several 175 h.p. compressor units and here again auto-synchronous motors are employed to give a leading p.f. Electric heating is used on the hoods of printing machines, on printing platens and for heating the doming tools on special card box making machines. Electrode boilers provide week-end steam in selected situations and also in special cases where oil-free steam is required. The maximum demand of the factory is about 9,500 kVA and about a quarter of the power is privately generated.

In the main factory of the Ellison switchgear works there are separate bays for the assembly of high and medium voltage switchboards, motor starters, circuit-breakers and smaller switches. At the Ellison A.S.T.A. proving station the plant consists of a 250 kW rotary convertor, providing a d.c. power supply at 220 or 110 V for generator fields, closing solenoids, oil pumps and other auxiliary equipment; test generators having a maximum output of 230,000 kVA at 6·6 kV, 1,500 r.p.m., 50 c/s with all winding ends available, enable windings to be connected to give a wide range of output voltages.

The works at Church Road of British Electrical Repairs, Ltd., handle, assemble, repair and re-wind all types of electrical plant and static apparatus. In addition to f.h.p. medium-size jobs, the re-winding, including conversion for changed operating conditions of large generators, motors, and transformers, in sizes up to 20 MW and 6,000 kVA, respectively, are dealt with.

In many respects the factory of the Austin Motor Co., Ltd., resembles a small town, with its own railway sidings, station and loading bays, nine miles of roadways, many restaurants and canteens, medical and welfare services. The great increases in production since the war have only been made possible by the large-scale adoption of unit-built transfer machines and comprehensive sequencing and conveyor systems.

During the day all the parties on the alternative visits met for lunch at the Witton Works of the General Electric Co. On the Thursday evening there was a dinner-dance at the Grand Hotel with the President, Sir George Nelson, in the chair.



Large rotating plant under construction (B.T.H.)

Friday's visits included the Hams Hall "A," "B" and "C" generating stations; the Birmingham factory of Bendix Home Appliances, Ltd.; and Lichfield Cathedral. Afterwards the three parties met for lunch at Hams Hall as the guests of the C.E.A. Midlands Division and the Midlands Electricity Board. Other parties visited the Rugby works of the English Electric Co., Ltd.; the Wolverhampton works of the Electric Construction Co.; the Stourport works of Steatite & Porcelain Products, Ltd.; the Kidderminster factory of Carpet Trades, Ltd., and the Stuart Crystal Glass Works at Stourbridge. Those parties attending the English Electric, Electric Construction and the Steatite & Porcelain Products companies' works were entertained to lunch by the respective companies.

Occupying a site of 25 acres, the Electric Construction Company's Bushbury Engineering Works, Wolverhampton, produces a wide range of a.c. and d.c. motors, air-break hand-operated motor control gear for s.c. and s.r. machines in capacities up to 30 h.p. 400 V; l.v. distribution switchgear in capacities up to 4,000 A 400 V; and horizontal draw-out pattern switchgear in capacities up to 300 A at 3.3 kV and 800 A at low voltage.

Steatite & Porcelain Products, Ltd., produce a wide range of high-voltage porcelain insulators for outdoor switchgear, transformers, and overhead lines; porcelains made by the pressing process for electrical accessories and appliances; and a wide variety of ceramic parts for the radio and television industries.

At the Stuart Crystal works visitors saw considerable use made of electrical equipment which includes a five-zone Telsen-Birlec electric annealing furnace rated at 65 kVA, and a 75 kVA three-zone Webert electric annealing furnace.

At the Carpet Trades factory the visitors inspected the dye house, winding department, and the seven weaving sheds which together house over 400 looms from 18in to 15ft wide. Power for the individual driving motors is supplied by the company's own generating plant.

BROWN-BOVERI JUBILEE

A LUNCHEON was arranged by British Brown-Boveri, Ltd., at the Dorchester, London, W.1, last Friday to celebrate the company's fiftieth anniversary. Mr. H. Oswald, managing director, presided and after lunch reviewed the company's history. He mentioned that Mr. A. C. Eborall was the first managing director; he was later chairman and retired from the board in 1947. He had sent a message regretting his inability to be present and Mr. Oswald said that he would shortly be celebrating his eightieth birthday.

Initially the company operated in many overseas territories and had branch offices in Canada, Australia, New Zealand and later Southern Ireland but eventually local organisations were formed and the company confined its business to the United Kingdom, except where contracts were in charge of United Kingdom consultants.

Mr. Oswald referred to contracts which had been carried out here. Some of the earlier larger steam turbo-generators (up to 7,000 kW) had been supplied by the company, including sets at Glasgow, Belfast, Edinburgh, Blackpool, London and Newcastle-on-Tyne. The first turbine-driven centrifugal air compressors and blowers in this country were Brown-Boveri machines; by 1910 Bolckow Vaughan & Co. had the largest furnace-blowing plant in the world at Middlesbrough—eight 25,000 cu ft/minute centrifugal blowers. The Brown-Boveri quick-acting regulator, developed in 1908, had found its way into practically every power station in Great Britain.

In 1920 three 10 MW B.B. turbo-alternators were installed in the Portobello (Edinburgh) power station; one of these was still in operation elsewhere. Two 19 MW sets at the Ferrybridge station of the Yorkshire Electric Power Co. (1925) were believed to have been the first 3,000 r.p.m. machines of that size. To-day Portobello contained larger sets of B.B. design but made under licence in this country and they were proud to say that the station was the most efficient one feeding the grid.

Mention was also made by the speaker to the company's mercury-arc rectifiers first introduced into this country in 1925 and since used largely for traction work. He regretted that the schemes propounded by Lord Verulam (who was present at the luncheon) for high-voltage d.c. transmission had not been adopted. Other references were to large interstage water-cooled compressors for colliery work; compressors for wind tunnels (up to 22,000 h.p.), steelworks, and air-conditioning; gas-turbine-driven supercharger blowers; gas-turbine locomotives; and finally to the eight electric tunnel kilns installed at the Barlaston pottery of Josiah Wedgwood & Sons.

Mr. Oswald was followed by Mr. R. Vodoz, chairman of the British company and a director of the Swiss parent concern, who proposed the health of the guests. He mentioned several of the distinguished men present, including the Swiss Minister in London and representatives of railways, consultants and industry. He concluded with a reference to Col. J. Reading, formerly assistant chief engineer, G.P.O., who was the first student engineer from Great Britain to go to the works of Brown-Boveri at Baden.

Mr. J. H. Wedgwood (deputy managing director, Josiah Wedgwood & Sons) replied for the guests and gave the toast of the company, testifying to the efficiency of the electric kilns mentioned by Mr. Oswald and to the quality of the ware which they produced.

Damages for Expelled Electrician

AN action brought by Mr. H. B. Harkness, an electrician, of Maryport, Cumberland, against the Electrical Trades Union, the hearing of which was begun in the High Court before Mr. Justice Streatfeild on Monday, 25th June, was settled in favour of the plaintiff on the following Friday. Mr. Harkness claimed for a declaration that his purported exclusion from membership of the Union on 29th July, 1955, was null and void and that he was entitled to be reinstated as a member. He also claimed damages.

Mr. D. J. Brabin, Q.C., in opening the case for the plaintiff, said that Mr. Harkness was, at the material time, employed by the United Steel Corporation, Ltd., at its Moss Bay Works at Workington. The claim arose out of national agreements concerning holidays with pay, under which employers were entitled to call upon men to work upon certain agreed days in return for extra pay. The agreed days locally included Good Friday and Easter Monday. In March, 1955, the Workington branch of the E.T.U. decided to take off all Bank Holidays, whether its members were paid for them or not, and this decision was later upheld by a majority of 37 to eight at a shop floor meeting. At a further meeting on 5th April an effort was made to get the members to change their minds, but the decision was still upheld. At both these meetings Mr. Harkness spoke up for working, and on Good Friday and Easter Monday he and a few others turned up for work.

The outcome of this was that an attempt was made at a branch meeting of the Union on 22nd April to charge Mr. Harkness with a violation of the rules in that he had, by his action, brought discredit upon the Union and its members. This failed because, contrary to the rules, a specially summoned meeting had not been called and proper notice of the charge had not been given. On 31st May proceedings were restarted to charge Mr. Harkness with attempting to bring discredit although, under the rules, there was no charge of "attempting" to do so. The meeting, by a vote of 44 to four, found the charge proved and approved a fine of £10. Mr. Harkness did not pay as he considered the whole thing was invalid, but he received a letter from the branch secretary informing him that unless he reduced his arrears of contributions to below 26 weeks he would be excluded from the Union. This was because, under the rules, an unpaid fine was treated as contributions in arrear.

On 29th July he attended a branch meeting but was not permitted to take part; he said he wished to give notice of appeal, but was told he was no longer a member of the Union. The following day he went to work and all the men stopped work because of him. The management, informed that the men would not work alongside a non-unionist, refused to dismiss him but, because of the men's attitude, he was suspended with pay. Mr. Harkness then offered to pay the fine and asked to appeal against his expulsion. He paid five shillings for re-admission, but was charged a further £50, which was £40 added to the fine of £10. This further sum he was unable to pay.

Obeying National Agreement

Mr. Harkness, in evidence, said that he had been an electrician for 30 years and a member of the Union since 1940. His union contributions had always been up to date, but he did not pay the political levy. He said that his conscience told him that they should obey the national agreements and he knew that his employers expected him to work. Of the unions in the local crafts committee, only the electricians chose not to work. Asked about the re-admission fee of £50, he said the Union wanted to be rid of him and were going to be rid of him. At the time he had only £62; now, his employers having stopped paying him on 14th November, he was £264 overdrawn and had had to deposit his life insurance as security.

Mr. J. A. Stuart, an electrician employed at the Moss Bay Works and a former shop steward, gave evidence for the plaintiff. He said that at the shop floor meeting he had proposed, and Mr. Harkness had seconded, a motion that they should work. Asked why he had done that, he replied that as the agreements had been signed by the firm and the unions at national level, and as the firm was expected to honour them, he felt that the men should also honour them. Questioned about the meeting at which Mr. Harkness's application for re-admission had been considered, the witness said that it was his opinion that those who wanted to impose the £50 fine were trying to prevent Mr. Harkness from getting back into the Union.

"Unlimited Discretion"

Mr. Dingle Foot, Q.C., opened the case for the defendants by saying that the men concerned were not bound by agreements arrived at at national or district level. But even if failure to work on the Good Friday and Easter Monday did involve breach of agreement, it did not follow that no charge could be made against the plaintiff. It would be a novel doctrine if it were held that a union member committed no breach of union rules by failing to withdraw his labour with the others just because that involved breach of an agreement. As to the re-admission fee of £50, this was not unreasonable; it was just over three weeks' wages. There was nothing in the rules that a sum in the nature of a penalty could not be imposed. There was an unlimited discretion.

Evidence for the defendants was then given by Mr. A. N. Dickinson, secretary of the Workington branch of the E.T.U. He said that Workington members were very displeased with the holidays-with-pay agreement and feeling about it was high. Members thought that Mr. Harkness and others, by disobeying the majority vote, had brought discredit upon them all. When questioned about the re-admission fee of £50, the witness said that the branch took into account that Mr. Harkness's action had involved 60 or 70 members in a strike which had cost each of them about £14 in wages. It was not looked upon as punishment, as it was suspected that the fee would be paid by the management. In cross-examination, he denied that the £50 fee was imposed to prevent Mr. Harkness rejoining the Union, but agreed that it was to the credit of the branch to get him out of the Union. Evidence was also given by Mr. A. V. Cattrell, secretary of the Workington branch of the Union for 14 years up to June, 1955, and by Mr. E. J. Beatty, the area secretary.

Terms Agreed

On Friday last Mr. Foot intimated that the parties had come to terms. He said that the defendants had thought it right to submit to judgment in favour of the plaintiff, in view of the fact that nothing was known at the national headquarters of the Union about the subject matter of this case until August, 1955, when a letter was received from the plaintiff asking for indulgence in the matter of his appeal, and nothing more was heard until the issue of the writ in the December following. But he (counsel) was obliged to make it clear that the defendants did not accept the plaintiff's main contention—namely, that he was entitled to ignore a majority decision—but it was realised that the charge, as framed, was ambiguous and the manner in which the proceedings had been conducted might have been irregular. The terms agreed were that there should be a declaration that the plaintiff was and had been since 12th January, 1940, a member of the defendant union and had been wrongly excluded therefrom, and that damages of £596 2s 5d should be paid.

Judgment was entered accordingly for the plaintiff on the terms agreed, with costs, Mr. Justice Streatfeild saying that he personally was extremely relieved that the parties had been able to come to terms in what was, to him, an increasingly distressing case the further it progressed. He could only say that he wished the plaintiff and the Union much more happiness in the future.

One Hundred Years of Water Power

The Story of Gilbert Gilkes and Gordon, Ltd.

WE recently visited the Kendal works of Gilbert Gilkes & Gordon, Ltd., and saw some of their installations in the Lake District, as part of the celebrations of the company's centenary year.

The company, a private one, employs about 210 people and has an annual turnover of about £400,000. It has belonged to the present owners and their forbears since 1881 and, a rare feature these days, no system of clocking-in or similar time checking arrangement exists for anyone working in the factory. The friendly atmosphere was apparent to everyone.

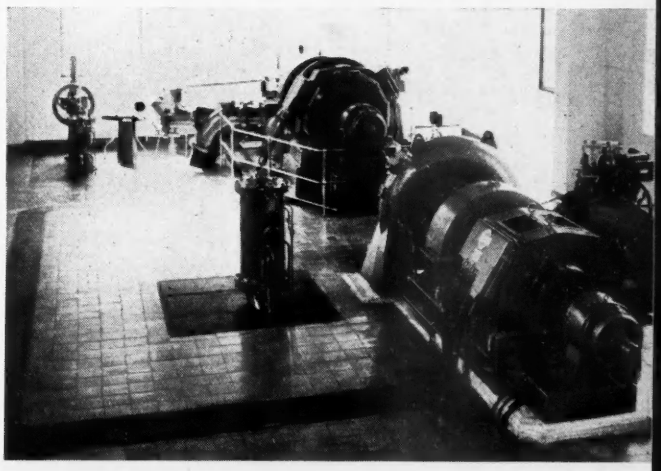
The first record of the company dates from April, 1856, when the canal warehouses, still in use as part of the works, were leased by the Kendal Town Council to the Williamson brothers, the predecessors of the present family in owning the works. Originally, general engineering work was carried on, including the manufacture of steam engines, saw benches and agricultural machinery, but in August, 1856, an order was received for a 5 h.p. Vortex water turbine to operate under a 31ft head. This had been invented just before by Professor James Thomson of Queen's University, Belfast, the elder brother of Lord Kelvin, and the original drawings of this turbine prepared by Professor Thomson himself are still in the possession of the company and are framed in the drawing office. This turbine, intended for driving agricultural machinery, is still in occasional use.

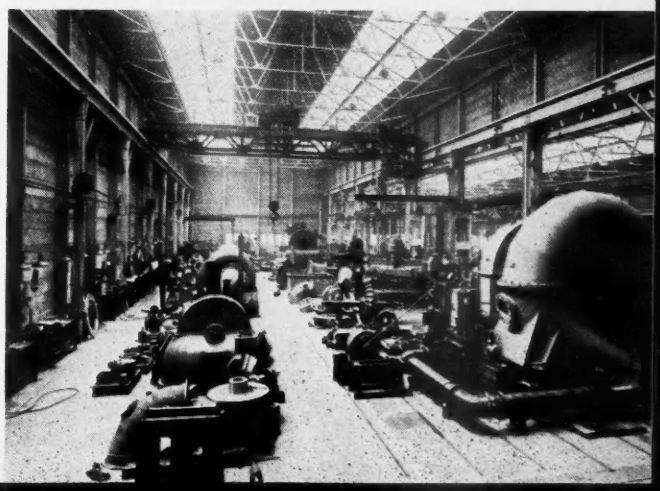
Many more were installed in the next few years; No. 6 is still supplying electric light for a country house in the vicinity. During the course of our visit to Kendal we were taken to see No. 330, which was built in 1876 and is still running every day driving a diamond saw and lighting generator at a slate and stone works in the Lake District. This is still in an excellent state of preservation though repair work has been carried out on the runner from time to time. The power is about 25 h.p.

Mr. Gilbert Gilkes purchased the business in 1881 and the name Gordon was acquired in 1928 by the water power connection of James Gordon & Co. of London.

The first Pelton wheel was designed for the company in 1894 and two 21ft diameter wheels of this type were supplied in 1903 to a tinplate company in South Wales. Around the turn of the century many turbines were being installed to drive electric generators, among the earliest of these being one supplied to the Greenside Lead Mines, Westmorland, to provide power for the first underground electric mine haulage scheme in the country. This was in 1893. Seven turbines were built in 1894 for Launceston in Tasmania, and in 1899/1900 two were supplied for electric lighting at Balmoral Castle. One of the turbines at Balmoral is still used but the other was replaced by a more modern Francis turbine in 1927.

In 1919 the Gilkes Turgo impulse wheel was invented by Mr. Eric Crewdson, who was chairman of the company from 1934 to 1954. This is a free jet impulse turbine in which the jet enters the runner from one side at an angle and is discharged upon the opposite side. Its great advantage is that its specific speed is substantially higher than that of a Pelton wheel and it fills the gap between Pelton and

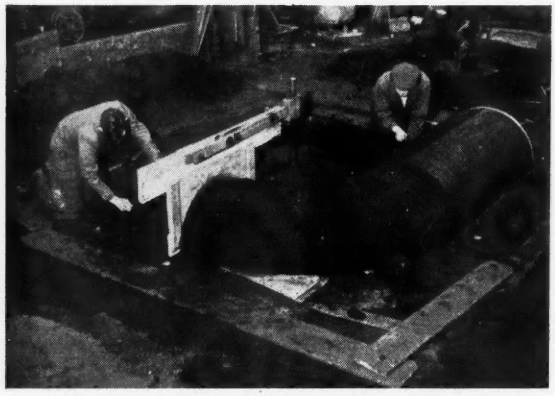




Above: Typical of the terrain in which Gilkes water turbines are installed is the Storr Lochs power station in the Isle of Skye, containing at present two 800 kW sets: a third is now being manufactured.

Top right: Inside the Kerry Falls power station where one 250 and one 500 kW units are installed.

Bottom right: The main turbine erection bay at Kendal.



" Strickles " in use to prepare the core for casting a spiral casing

Francis-type turbines where moderate powers are required. It virtually eliminated the need to build multi-jet Pelton wheels as its speed is ever higher than that of a two-jet Pelton wheel. The turbine itself is smaller and simpler, and many hundreds are being used all over the world.

A considerable part of the works at Kendal is occupied by the foundry which deals with iron castings only, up to about five tons weight. An interesting technique is that of manufacturing cast spiral casings for Francis turbines. This is done by floor moulding methods since the production is normally for one-off only. Wooden formers are made, known as "strickles," conforming to the diameter of the spiral casing at different parts of its circumference. These are used to set the shape in the floor moulding at the proper point and the shape of the spiral casing is built up by skilled interpolation between the various points. The core is formed similarly by matching "strickles," part of the process being seen in the above illustration. For jobs where only one casting is required this method has the advantage of not requiring expensive patterns each time but it is, of course, a highly skilled task.

A number of power recovery turbines have been made in recent years and an interesting installation built by a concern bought up by Gilkes, and since re-designed by them, is at the I.C.I. Billingham works where two 2,000 h.p. Pelton wheels still operate twenty-four hours a day recovering power from large volumes of water containing CO_2 in solution. It is 30 years since these were first installed. The most powerful turbine the company has made is one of 9,000 h.p. operating under a head of 2,600ft in the Andes for the Bolivian Power Co., and the most powerful in the United Kingdom is a 3,600 h.p. Francis machine operating under a head of 80ft and installed in an underground power station at Loch Mullardoch, the main reservoir of the Glen Affric hydro-electric scheme in Scotland. This utilises power as the water flows from this main reservoir to a smaller one at Loch Benevean. The low speed turbine drives a generator through step-up gearing.

Many advances in governor design have been made by Gilkes ranging from the shaft governor for impulse turbines to the "Giljet" governor system using impulse type hydraulic brakes to absorb power when the speed of the turbine rises upon the removal of load. Suitably designed buckets are formed in the rim of a totally shrouded flywheel. The company also manufactures a range of self-priming pumps, many being sold for marine purposes and for the cooling of marine engines and for crop spraying.

Since the war it has been possible to extend the works and a modern addition of 20,000 sq ft has been constructed, used mainly as a machine shop. A new testing section has just been completed in which two test tanks have been provided with associated measuring weirs for testing pumps of a maximum output of 2,000 g.p.m. with an input horse-power up to 150.

Transport Commission's £30 Million Deficit

A NET deficit of £30.6 million on the operations of the British Transport Commission last year (compared with a loss of £11.9 million in 1954) brought the accumulated deficiency up to £70 million. The Commission's report and accounts* published last week show that there was a working surplus of £29.5 million before meeting interest and other central charges (£55.5 million) and capital redemption and special items (£4.6 million). Two important reasons for the deficiency were the partial strike of locomotivemen, lasting 14 days, and the delay in obtaining approval of higher fares to meet earlier wage increases. In mid-year the price of coal was raised, costing the Commission an extra £8 million a year and in addition to higher prices of other materials there were increases costing £2 million a year in National Insurance payments.

Measured in passenger-miles, the traffic carried by the Commission's services was 1.5 per cent less than in 1954, the biggest decrease being experienced on London Transport road services, largely due to the steady growth of private transport. As an indication of the economies achieved from increased efficiency, the Commission's report points out that the staff of British Railways has been reduced by almost 100,000 since the middle of 1948 though the total ton-miles and passenger-miles carried by the railways has remained roughly the same.

Capital development gathered momentum; altogether some £72 million was spent during the year on new rolling stock, road vehicles, plant and equipment, and about £9 million on additions and improvements to land, civil engineering works and buildings. Reference is made to the decision to adopt the high-voltage 50 c/s system of railway electrification which will be used on about 1,200 of the 1,460 route-miles of line to be electrified as a first instalment under the Modernisation Plan. The remainder, in the eastern section of the Southern Region, will consist of extensions of the existing d.c. third-rail system. A scheme covering 248 route-miles in East Kent was ready for authorisation by the end of the year. The change of frequency from 25 to 50 c/s on the Southern Region is now entering its final stages.

Work on the overhead equipment and substations for the extension of electrification on the Eastern Region from Shenfield to Chelmsford (opened last month) and Southend Victoria (to be opened next January) has proceeded satisfactorily and planning and survey work has been carried out for the electrification from Fenchurch Street to Southend Central and of the lines from Liverpool Street to Enfield, Chingford, Hertford East and Bishop's Stortford.

*Report 4, Statement and Accounts and Statistics 7s 6d, from H.M. Stationery Office. Notes on Report 1s, from British Transport Commission.

VIEWS on the NEWS

By REFLECTOR

AT Eastbourne I again heard several delegates reiterate the claim that because of the after-sales services which they render they are entitled to special terms from manufacturers or wholesalers. They certainly are expected to earn their money. As the spread and variety of electrical appliances grow the rendering of that service becomes an increasingly difficult undertaking, as has been found in the United States. The subject is studied in a recent article in the *Electrical World* from which I gather that the problems (or "bugs," as the author calls them) are much the same there as here. Customers complain about the high cost of repairs (caused by rising labour costs, etc.) and delays in returning appliances upon which they are so dependent due to the inability of dealers to carry spares of the many parts required which necessitates securing them from manufacturers. The author suggests that the position would be improved if the insides of appliances were easier to get at, making repair a simpler matter. Standardisation is needed to reduce the number of replacement parts which have to be stocked. Manufacturers should assist in the training of service men by issuing instructional material and the customer should be encouraged to read operating instructions; many breakdowns are caused by their failure to do this.

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I was glad to hear of the admission by the Electrical Trades Union that one of its members may have been unjustly treated, although it took a High Court action to secure it. There was certainly more than a suspicion of vindictiveness about the conditions on which the plaintiff in the case was offered reinstatement as a member after his expulsion. That expulsion arose out of the man's loyalty to an agreement which other members of his branch decided not to adhere to. After several days' hearing the Union settled the case out of court, agreeing to pay £596 in damages. Fair-minded people will concur in the judge's hope that the bitterness engendered in the Workington branch would not be allowed to continue and that they would "welcome the plaintiff back as a brother as he was formerly called."

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Among the devices demonstrated at the recent Conversazione of the Institution of Civil Engineers were a number of burglar alarms. One of them, a supersonic generator, sets up a stable pattern of sound waves above the aural range throughout the space to be protected. The movement of anybody in that space upsets the pattern and actuates a detector and alarm. *The Times* in one of its occasional playful headlines called this "No Visible Cause for Alarm."

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Indignant letters to newspapers complaining about the number of men sent by Electricity Boards to do simple jobs are fairly frequent, and just as frequently I wonder whether they are really justified. No doubt there are cases of duplication or bad organisation and, of course, there is always the question of "demarcation" which prevents a man of one trade from trespassing upon the domain of another craftsman. Recently a Lincolnshire farmer was annoyed when, as he alleged, four men turned up to read his electricity meter. He said, as reported by the *Lincolnshire Echo*, that "one man read the meter, three sat in a van outside—and one of them was asleep." It turned out, however, that the three men in the van had finished their rounds in neighbouring villages and were being given a lift back to base by the fourth, who was making his last call.

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"Brains trusts" are now as popular a form of instructive entertainment as spelling bees once were. To some extent, I suppose, an audience derives as much pleasure from the baiting of panel members as people do from the heckling of Parliamentary candidates, but they certainly expect more information. Already the "Electrical Forum" has established itself as a regular item in the programme of the British Electrical Power Convention, and this year the Electrical Contractors' Association tried out the idea. There seems to be no doubt that it was generally welcomed, although one heard suggestions that there was too much of it—about three-and-a-half hours split between two sessions. There was also a sameness about many of the questions, but that was no fault of the organisers. Unless questions are "inspired" (and that detracts from the spirit of the occasion) there is apt to be some lack of balance. The remedy is to have more questions than are needed and make a judicious, not prejudiced, selection.

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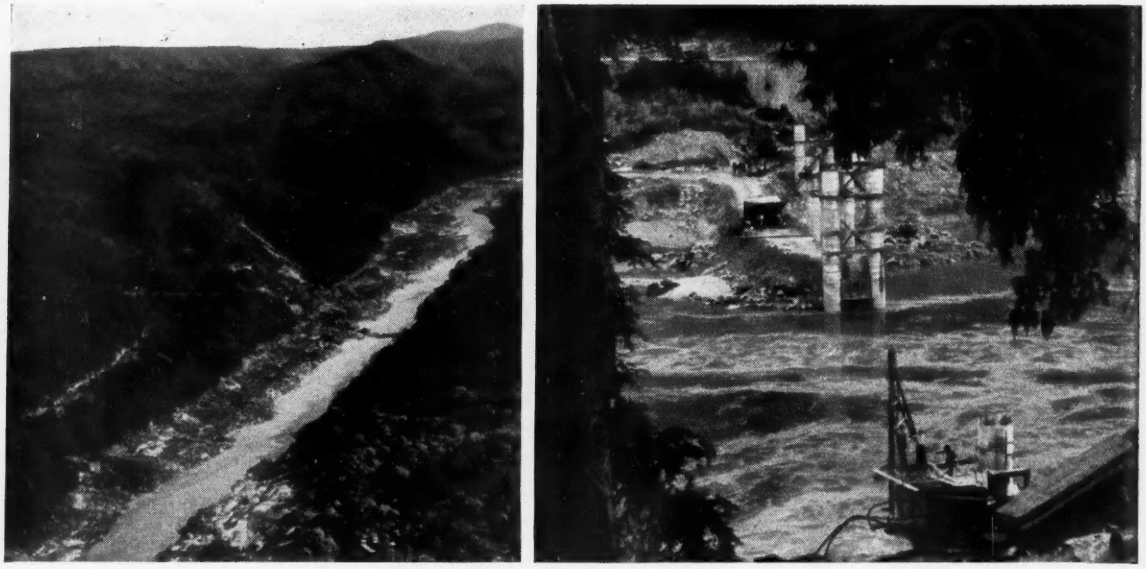
An early form of "walkie-talkie" was described at some length in the *Electrical Review* eighty years ago (1st July, 1876). This, of course, was of the cable telegraph variety and, from the illustrations, quite cumbersome. The system, the invention of a M. Trouvé, consisted of a two-wire cable connecting two "stations," i.e., the officer sending the messages and the soldier receiving them. The officer carried on his belt a battery and a telegraph instrument, which he could put in his pocket or hang on his epaulet, while the soldier had strapped on his back a bracket bearing a large bobbin for the cable and a battery, in addition to which he held a telegraph instrument. Enough cable was carried for the soldier to advance a distance of a kilometre. The article explained that:—

> "The soldier carrying the bobbin seeks out parts inaccessible by carriages; if he has a certain route to traverse he would give preference to a locality where the trees would allow him to carry the wire sufficiently high to allow carriages and cannons to pass beneath it, for it will be understood that if the wire was laid along the road it would run the risk of being crushed and cut by wheels passing over it. Practically, for this reason, it is necessary to furnish the telegraphist with an assistant for lifting the cable on the branches of trees and for various other emergencies."

Some assistance was certainly needed on the return journey, unless the soldier was a contortionist, for the cable had to be rewound by means of a handle on the bracket carried on his back.



Aerial view of Kariba Gorge looking downstream towards the dam site and (right) pile driving in progress. The pictures were taken during the dry season

Kariba Hydro-Electric Scheme

FIRST PHASE OF 1,200 MW DEVELOPMENT

THE World Bank has approved a loan of £28.6 million in various currencies for the first stage of the Kariba hydro-electric scheme in the Federation of Rhodesia and Nyasaland. The loan will help to finance the building of a dam and power plant with a capacity of 500 MW and nearly 1,000 miles of transmission lines linking the station with the Copperbelt in Northern Rhodesia and the principal cities of Southern Rhodesia. The cost is expected to be about £80 million. The loan, the largest the Bank has ever granted for a single project, will be made to the Federal Power Board which will be responsible for the construction and operation of the scheme and will control the output of most of the existing thermal stations when they are connected to the grid.

Two Underground Stations

The full Kariba project will make available 1,200 MW of hydro-electric power to meet the continually expanding demand. In the first stage now being undertaken an arch dam will be constructed across the Zambesi River at the Kariba Gorge, about 170 miles from Salisbury. The dam will be some 400ft high and 1,800ft long at the crest; the head for power generation will be 300ft. The reservoir behind the dam will be 190 miles long and 40 miles across at its widest point. Under the full scheme two underground power stations will be built, one on each side of the dam and each equipped with six 100 MW sets. In the first stage one of the stations will be built and equipped with five sets. The stage also includes the construction of a grid interconnecting the major load centres in the Federation. A high-voltage transmission line will run 275 miles northward from Kariba to Kitwe in the Copperbelt and southward to Norton and Umniati, and thence to Bulawayo and Salisbury, the two largest cities in the Federation. The combined length of the lines to the south will be 650 miles. The Federal Power Board has retained an international group of engineers to plan and supervise the construction of the project. Preliminary work has already begun and the first power is expected to become available by 1960, the initial stage reaching its full output of nearly 4,000 million kWh per annum by 1963. The second stage will be carried out when the growth of demand justifies it.

Power for Mining Industry

The Federation now rivals Chile, being the world's second largest copper producer and the main supplier of copper to the sterling area countries. Copper production exceeds 400,000 tons annually and in 1954 the value of copper exports amounted to £86 million. The Federation produces a variety of other minerals, including gold, lead, asbestos, chrome and coal, and is increasingly moving towards industrialisation. Mining and industry now consume 78 per cent of the power produced in the country and a considerably larger supply is essential to their continued growth. It is estimated that an additional 650 MW will be required by 1965 and at least 1,100 MW by 1972.

Studies have shown that the development of the power potential of the Zambesi River at the Kariba Gorge can provide firm power in the amounts needed to satisfy expected requirements until about 1970 for an investment only slightly greater than that required to expand thermal capacity, without taking into account the mining and railway expansion that increased thermal capacity would involve. The cost of power from Kariba, as soon as the first stage reaches full load, will be appreciably lower than that of thermal power and will decrease as the second stage is developed. The Kariba scheme will have the advantage of balancing the power system by interconnecting hydro-electric and thermal sources and will relieve the pressure on the railways by reducing coal haulage for power stations.

Nuclear Reactor Physics

FOUR-DAY CONFERENCE IN LONDON

A CONFERENCE on the physics of nuclear reactors sponsored by the Institute of Physics has been taking place at the Institution of Electrical Engineers in London this week. The purpose of this conference is to keep members of the British Nuclear Energy Conference abreast of scientific development in nuclear reactors and to call their attention to the problems needing solution. The conference is primarily intended for industrial and government physicists working, or likely to work, directly or indirectly with reactors and for lecturers and other teachers. The conference was opened on Tuesday last by Sir John Cockcroft, who delivered an address on scientific problems in the development of nuclear power.

Sir John explained that the scientific problems in the development of nuclear power divided conveniently into physical, chemical and metallurgical. The physicist was concerned with predicting the nuclear performance of reactors. He had to be able to predict the critical size and the amounts of fuel and the degree of enrichment required to enable it to operate at the designed heat output. He had further to be able to predict the course of the reactivity—how much heat could be extracted per ton of fuel before the fuel had to be changed. To do this he had to know a great deal about the interaction of neutrons with the important heavy element isotopes inducing plutonium 240 and 241. He must know how the number of neutrons per fission changed with neutron energy and the relative chances of a neutron being captured with and without producing fission. He must know the chances of neutrons being absorbed by the fission products formed in the fuel elements and any non-fissile materials used by the metallurgists and engineers. Different data were required for fast and thermal reactors. The physicist must also keep a watchful eye on the safety of reactors—he must be wary lest changes in temperature or operating conditions induced additional reactivity and caused power increases. He must also study the effects of high speed, high intensity neutron bombardment on the properties of important structural materials in the reactor such as graphite and steel.

Nuclear Materials

The chemists and metallurgists had the problem of providing all the nuclear materials (fissile and non-fissile) in a high degree of purity. The chemists must devise processes for separation of fertile materials, fissile materials and fission products. The metallurgist had to understand the effect of radiation on uranium and thorium metal at the operating temperature and devise methods of counteracting deleterious effects. To do this he had to study the various possible alloys or cermets, bearing in mind the prohibitions of the physicist who disliked neutron absorbing materials and the chemist who disliked the job of processing highly alloyed metals.

The chemists and metallurgists had also to study the compatibility of all the materials used with the coolants specified by the engineer. Thus the reaction of graphite with carbon-dioxide gas at 400 deg C in the presence of reactor radiation must be measured; the compatibility of liquid sodium with zirconium and stainless steel at 550 deg C must be determined for a reactor of the sodium-graphite type; solutions of uranyl sulphate in water must be compatible with structural materials used in homogeneous reactors. All these problems required prolonged study in test rigs or reactor experiments.

The scientist must also plan ahead, for any new type of reactor was likely to take at least 10 years to come into full-scale use from the commencement of work. During this period he had to carry out research and development on any new materials which might be required, such as heavy water, thorium, zirconium and beryllium. Work has to be started many years before full-scale use could be certain. The crystal ball was never more required than in the development of atomic energy.

Advanced Reactors

On Wednesday morning Dr. J. R. Dietrich, Argonne National Laboratory, U.S.A., dealt with the physics of advanced reactors in an attempt to characterise the various promising types of solid fuel power reactors in terms of the neutron-physics characteristics of their moderators, coolants and fuel cycles. The neutron-physics design objectives which had the greatest effect on power cost were: (i) use of a fertile isotope (uranium 238 or thorium 232) as a major source of energy; (ii) internal conversion ratio high enough to allow long fuel element life; (iii) safety characteristics favourable enough to avoid remote siting and high containment cost. These objectives were not restrictive enough to define the "best" reactor type, but they were the major factors in determining the composition and geometric arrangement of specific reactor designs once the type had been chosen.

The thermal reactors which were at present being designed or constructed used uranium 235 as the initial fissile isotope, and there was a strong incentive to utilise ratios of fissile to fertile material which departed as little as possible from the "natural" value. With this additional design restriction, the lattice characteristics appropriate to the various moderator-coolant combinations were still more sharply defined. Dr. Dietrich drew examples from the current group of reactor designs to illustrate these characteristics. He also discussed the possible consequences of a greater latitude in the choice of fissile-fertile ratio and considered the relative characteristics of the possible fuel cycles.

The characteristics of fast reactors fitted into a quite different pattern. The possible conversion ratio was high on either fuel cycle, and the reactivity changes associated with fuel burn-up were relatively low simply because of the very large fissile-material content of the reactor. The requirement that the average neutron energy be kept high was a rather restrictive one. It appeared now that the range of variation in fast reactor design would be less than that in the thermal reactor field. Dr. Dietrich presented the characteristics of typical fast reactors, discussed their special problems and quoted some recent experimental results.

In the afternoon a lecture on experimental reactor physics was delivered by Mr. P. W. Mummery, Atomic Energy Research Establishment, Harwell. He said that the successful design, construction and operation of nuclear reactors required detailed information concerning the interaction of various nuclear radiations with matter. In principle this could be obtained from a knowledge of fundamental atomic and nuclear properties combined

with mathematical treatments. In practice a considerable number of integral measurements were required. These experiments measured combinations of various fundamental atomic and nuclear properties and the prediction of the mathematical treatments. Mr. Mummery outlined the detailed information required and discussed various integral measurements together with their correlation with fundamental data and with various mathematical models. He also considered the use of sub-critical, and low-power and high-power critical reactor assemblies in this field.

The next lecture was delivered by Dr. L. R. Shepherd, Atomic Energy Research Establishment, Harwell, who dealt with the zero energy fast breeder reactor ZEPHYR. This was a small low-power fast reactor with a plutonium core surrounded by an envelope of natural uranium. No cooling was required since the maximum operating power was about 2 W. This reactor first diverged in February, 1954, and had been used to make a detailed study of the neutron physics of fast reactors. Of the many aspects investigated, particular attention had been given to a determination of the breeding characteristics of the system and the measurement of the nuclear parameters required for a theoretical interpretation of fast reactors. The next discourse was given by Prof. R. E. Peirls, University of Birmingham, who dealt with recent developments in nuclear theory.

Irradiation Effects

The effects of irradiation on the physical properties of solids were dealt with on Thursday morning by Dr. A. H. Cottrell, Atomic Energy Research Establishment, Harwell. He explained that ionising radiations dissipated most of their energy in solids by ionising and exciting electrons. Severe radiation damage was produced in organic and ionic substances by this process, but in metals the flexibility of the free electron structure conferred substantial immunity to ionisation damage. Atoms in metals were displaced by collisions with fast particles, and the point defects so created altered the electrical conductivity and other physical properties of metals. These point defects interacted strongly with dislocations, with the result that the mechanical properties of metals were very sensitive at low temperatures to heavy-particle bombardment. In semi-conductors the displaced atoms could trap conduction electrons and so produce large changes in electrical properties. Very intense particle bombardment produced drastic effects. Some minerals became non-crystalline; uranium crystals changed their shape markedly; and rare gas atoms created by transmutations within the material might cause disintegration in brittle crystals and swelling in ductile ones.

Shielding

In a paper on shielding for reactors, by Dr. G. C. Laurence, Atomic Energy of Canada, Ltd., Chalk River, a brief general discussion was given of the design of shielding for nuclear reactors. It included consideration of design requirements, choice of materials and dimensions, nuclear reactions that affected the penetration and heating of the shielding. Because the basic data available were insufficient for high accuracy in design calculation, the use of very complex theory and very laborious calculation had little advantage. Approximate methods were used, and allowance was made for possible error in calculating the thickness of the shielding. These approximations were discussed. The problem was simplified by neglecting radiation processes that had relatively little effect on the overall penetration, but the importance of these effects depended on the design of the shielding.

The next paper was read by Dr. A. J. Salmon, Research Laboratory, Associated Electrical Industries, Ltd., who spoke on the control of reactors. The concepts of reactivity, neutron lifetime and delayed neutrons were described and their relationships with the rate of change of neutron density and reactor power discussed. The amounts of reactivity to be controlled in a reactor might be large and vary with time; the various components of this reactivity were noted and discussed. The physical methods of control were surveyed and the safety of reactors briefly considered.

Instrumentation

The instrumentation of reactors was next discussed by Mr. W. Macrae, C. A. Parsons & Co., Ltd. All reactors produced power, their normal operating level ranging from the order of 1 W in so-called "zero energy" experimental reactors to hundreds of megawatts in power reactors. It was with the measurement and control of this power and its effect on the temperature of the reactor components and the coolant (if any) that most of the instrumentation of a reactor was concerned.

There were two main groups of instruments, those operated from detectors sensitive to neutron flux (flux measuring instruments) and those concerned with physical measurements such as temperature and coolant mass flow. The principles of operation of the various instruments were described and their relative importance under various operating conditions indicated. In power reactors, instruments were also necessary for the detection of faults in protective fuel containers. The paper concluded with an assessment of the instrument requirements for a large power-producing reactor.

The next lecture was delivered by Dr. R. Spence, Atomic Energy Research Establishment, Harwell, who discussed the role of chemistry in a nuclear energy project, and he was followed by Mr. L. Rotherham, Industrial Group Headquarters, U.K. Atomic Energy Authority, Risley, who spoke on the role of metallurgy in a nuclear energy project.

To-day, Friday, Dr. W. B. Lewis, Atomic Energy of Canada, Ltd., Chalk River, is to present a paper on the Canadian research reactors and their uses, and finally Mr. F. W. Fenning, Atomic Energy Research Establishment, Harwell, will describe the United Kingdom research reactors and their uses.

International Nuclear Conference

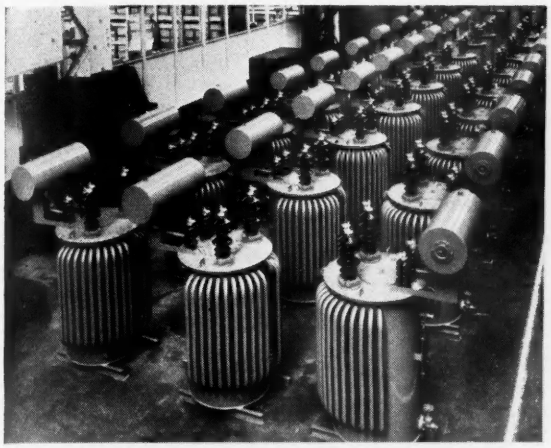
Four further volumes in the series of 16 which are being compiled by the United Nations under the title of "Peaceful Uses of Atomic Energy" have now been issued. These contain the full text and verbatim transcript of the discussions of the 1,050 papers on the subject that were presented before the international conference at Geneva last August. The first volume of the series to be published was No. 3, relating to power reactors (see *Electrical Review*, 3rd February). Those now under mention are numbered 1, 2, 4 and 15. Their subjects are the role of nuclear power in meeting the world's requirements for energy, research reactors, cross-sections of fissionable and fertile materials, and applications of radioactive isotopes and fission products in research and industry.

To judge from the contents of the volumes now available, from the titles of those still to come and from our own attendance at the Geneva conference, the claim of the responsible organisation appears to be justified that the information made available, much of it for the first time internationally, will "remain the standard text and basic documentation on this subject for many years." The volumes are obtainable, Nos. 1 and 2 at 57s and Nos. 4 and 15 at 54s each, from H.M. Stationery Office, Box 569, London, S.E.1.

INDUSTRIAL NEWS

Transformers for the United States

A batch of distribution transformers made by the English Electric Co., Ltd., left Liverpool Docks recently for Portland, Oregon, U.S.A. From Oregon they will go by rail to their destination in Idaho. These transformers will be used on the Minidoka Project, a scheme for irrigating some 200,000 acres of land in the Snake River Valley. The English Electric Co. has built many large high-voltage power transformers for America but the present contract is the first received for distribution-type transformers built at the company's Liverpool works.



Transformers for dispatch at the Liverpool Works of the English Electric Co., for the Minidoka Project, United States

Electric Vehicle Order

Smith's Delivery Vehicles, Ltd., Gateshead-on-Tyne, has received an order for a further thirty NCB electric one-ton dairy trucks from the Royal Arsenal Co-operative Society through the agency of the C.W.S. Motor Trade Department. The special features of these vehicles are the detachable bodies and cabs which are being produced to a design evolved by the Coachbuilding and Engineering Departments of the R.A.C.S. The bodies and cabs are of bolted composite construction, with corrugated aluminium floor section and steel roofs for carrying empty crates. Batteries are by Crompton and D.P. and chargers by Westinghouse, while all electrical equipment incorporated in the chassis is by the British Thomson-Houston Co., Ltd.

Financial Help for Technical Students

Mr. F. D. Edwards, founder and managing director of Edwards High Vacuum, Ltd., has formed the "Frederick D. Edwards Scholarship Trust." The trustees will have a very free hand in granting financial assistance to students in science and technology in any way they think fit. The whole of the capital and income of the trust fund (amounting to £12,000) is to be spent within ten years.

Although three institutions are specifically mentioned in the trust deed—the Northampton Polytechnic, the National College of Instrument Technology and the Crawley Technical College—those who wish to attend any other institution "giving training courses or facilities for research in any branch of science or technology" are equally eligible. Inquiries about the trust and applications for grants should be made through college principals to either of the two trustees: Mr. F. S. B. Murrells (director and secretary, Edwards High Vacuum, Ltd.), Tresco, Nevill Court, Tunbridge Wells, Kent, or Mr. A. J. Philpot (retiring director of the British Scientific Instrument Research Association), Cranley, Bressey Grove, E.18.

Historic Electrical Apparatus

From Thursday to Saturday last week an exhibition of historic electrical apparatus was arranged by the Eastern Electricity Board to commemorate fifty years of electricity supply in Hendon. The exhibition, which was staged in Hesco Hall adjoining the Board's showrooms in Brent Street, was officially opened by the Mayor, Councillor L. Chainey, Mr. H. C. Waters, M.I.E.E., deputy chairman, Eastern Electricity Board, was also present.

Practically all the apparatus was lent either by manufacturers or the Central Electricity Authority, and exhibits included an example of an early pattern fusegear incorporating a metal strip fuse; a 1914 Belling fire; a 5 h.p. motor made by Cromptons about the turn of the century; a 1926 Electrolux vacuum cleaner; a 1913 Jackson electric cooker; and a wooden washing machine (not electric) a century old, lent by the English Electric Co., Ltd. In contrast several examples of present-day appliances and equipment were shown, including a modern sodium street lighting lantern.

As an indication of the growth of the undertaking over the last fifty years it is interesting to note that in 1908 the total connected load was only 124 kW. and during that year 110,000 kWh was supplied to 443 consumers. The population was then 25,000 compared with 175,500 at present and the number of consumers has risen to nearly 56,000 with an annual consumption in the region of 190 million kWh.

Hydro-Electric Plant for India

An Indian contract for the supply and erection of five water turbines and their alternators, to a total value of some £1,250,000, has been awarded to the English Electric Co., Ltd. This is believed to be the largest contract of its kind for India ever placed with a single

General view of Eastern Electricity Board's exhibition of historic electrical apparatus

manufacturer. The sets, each developing 77,000 h.p., are for a new power station on the Rihand River, a tributary of the Sone, near Pipri Village, south-east of Allahabad in Uttar Pradesh. The station is to feed power into the Ganges Plain network to meet increasing demands for the supply of electricity for agriculture and industry.

The placing of this contract with the English Electric Co. by the Uttar Pradesh Government follows the recent commissioning of Khatima power station in the north of the Province, for which the company supplied and erected under a comprehensive contract the entire plant and equipment, including three 19,200 h.p. vertical feathering propeller type water turbine sets, switchgear and transformers.

Mr. E. C. H. Organ, chief engineer of the G.E.C. Telephone Works, Coventry, explains the functions of the transistor to the Nigerian Minister of Communications, the Hon. Dr. K. O. Mbadiwe, during his recent visit to the works. Behind Dr. Mbadiwe is Mr. O. W. Humphreys, G.E.C. director of research

Cable-Makers' Premium Payments

The Joint Industrial Council for the Electrical Cable-making Industry has announced revisions of premium payments for night work, shift systems and Saturday work. For night shift, pay will be at daytime rate and one-third (in place of daytime rate and one-quarter). Under the double-day shift and three-shift systems, for the second shift payment will be made as if 9½ hours were worked (in place of 9¼ hours), and for the third shift payment as if 10¾ hours were worked (in place of 10 hours). For Saturday day work, all time worked will be remunerated at time and a half, and for shift systems time and a half for the first and second shifts, and time and a half for the first two hours and time and four-fifths thereafter for the third shift. The above changes take effect on the third pay day in July in respect of the period for which payment is then made.

Lighting at New Lamp Works

Fluorescent lighting has been installed in the recently opened factory at Buckie, Banffshire, of the British Thomson-Houston Co., Ltd., for the manufacture of telephone switchboard indicator lamps and other lamps. Twin 5ft reflector fittings with upward light slots have been used for general illumination. Single lamp 5ft fluorescent reflector fittings provide the high level of local illumination needed for the accurate assembly of the lamp and the manipulation of the tungsten filament.

Tanker Radio Aids

Two new tankers for the Eagle Tanker Co., Ltd., have been fitted with a comprehensive range of Marconi Marine communication equipment and radio aids to navigation. They are the *San Fortunato*, 18,000 tons, built at Birkenhead by Cammell Laird & Co., Ltd., and the *San Felipe*, 18,000 tons, built by Smith's Dock Co., Ltd., South Bank on Tees.

Training at Metropolitan-Vickers

The Metropolitan-Vickers Electrical Co., Ltd., has issued two booklets giving details of two of its educational and training scholarship schemes for boys who wish to make a career in professional electrical or mechanical engineering. "Pre-University Training for Professional Engineers," describes the probationary college apprenticeship course, which is recommended for the boy who intends to proceed to a university to read for a full-time engineering or science degree. The course comprises one year's training in the works both before and after completion of a full-time degree course. All candidates accepted are offered one of the company's university maintenance scholarships. These have an average value of £300 per annum throughout the three years of a university degree course. "From School to Professional Engineering" advocates training by means of the school or special apprenticeship courses for boys who are unable to proceed to university for a full-time degree course.

These apprenticeships enable engineering studies to be carried out concurrently with training in the works. Applicants who are accepted for either of these courses are considered for entry to the "sandwich" courses run in conjunction with the Royal Technical College, Salford. Rates of pay throughout the periods of training and full-time study and spread over the duration of the "sandwich" courses are the equivalent of a scholarship worth approximately £300 per annum.

Educational

Courses of lectures on various specialised subjects in electrical engineering commence in October at the South-East London Technical College, Lewisham Way, S.E.4. They cover high-voltage engineering, electrical engineering economics, communication engineering economics, vector analysis and fundamental electromagnetic theory, operational calculus with applications to electric circuit theory, optical instruments, and electric power transmission calculations. Applications for admission to these courses should be made to the head of the Electrical Engineering Department of the College.

Radio at Damascus Fair

Seven leading British radio and television manufacturers are taking part in a composite stand under the auspices of the British Radio Equipment Manufacturers' Association at the United Kingdom Pavilion in the Damascus International Fair, to be held from 1st to 30th September next. The pavilion is being organised by British Overseas Fairs, Ltd., the subsidiary company of

Section of the first lamp production line to be installed at the new B.T.H. Buckie Lamp Works

the Federation of British Industries. The seven manufacturers participating in the composite exhibit are: Bush Radio, Ltd.; E. K. Cole, Ltd.; A. C. Cossor, Ltd.; Ferguson Radio Corporation, Ltd.; General Electric Co., Ltd.; Kolster-Brandes, Ltd.; and Regentone Radio & Television, Ltd. Other manufacturers of radio and electronic equipment taking part in the Fair independently of the B.R.E.M.A. composite stand include Ever Ready (Great Britain), Ltd., the Metropolitan-Vickers Electrical Co., Ltd., Mullard Overseas, and James Neill (Sheffield).

Engineering Employers Reject Claims

At a meeting last week with representatives of the trade unions, the Engineering Employers' Federation rejected claims by the unions for a 40-hour week and increased pay for holidays. The Federation also reiterated its previous announcement that it could not consider the projected demand for an all-round increase in wages.

In announcing their decisions the employers made it clear that they were not averse from paying higher wages for increased production, but the time had come when they must refuse to contribute further to the causes of inflation.

Representatives of the unions expressed indignation at the rejection of a wage claim before it had been presented and said that they would have to consider what action to take to enforce their demands.

Model Forms of General Conditions of Contract

Two new model forms have been prepared by the Joint Committee on Model Forms of General Conditions of Contract of the Institutions of Mechanical and Electrical Engineers, and published under the authority of the Councils of the two Institutions with effect from 1st July. They are: B.1, for use in connection with Export Contracts with delivery f.o.b. or c.i.f.; and C, for the sale of electrical and mechanical goods, other than electric cables (home—without erection).

Form B.1 is the second in the series of model forms for export contracts to be recommended by the two Institutions and the Association of Consulting Engineers (B.3, "Export Contracts including delivery to and erection on site," was published in May, 1954). The new Form B.1 supersedes the existing Electrical Model Form B.1 issued in 1928 by the I.E.E.

For electrical f.o.b. contracts with supervision of erection, use may be made, pending the preparation of a corresponding model form by the Joint Committee, of the relevant parts of the existing Form B.2, "for use in connection with export contracts (including complete erection or supervision of erection)," which is available from the I.E.E.

The attention of users of these model forms is drawn to the fact that because of the constant process of revision by the Committee, it cannot be assumed that in a given series (e.g. the "B" Export Series) the various forms will differ only in so far as the type of contract to which they refer makes necessary, and that "standard" clauses (e.g. the arbitration clause) will necessarily remain the same throughout the series.

The prices of the two new model forms, including postage, are: B.1, 4s 6d; C, 2s 6d.

Lower TV Running Costs

The prices of modern types of cathode ray tube and radio valves produced by members of the British Radio Valve Manufacturers' Association have been reduced as from 2nd July. Examples of savings to the public on cathode ray tubes are:—21in, from £31 18s 7d, including purchase tax, to £26 8s 6d; 17in, from £24 19s 2d to £20 11s 1d; and 14in, from £20 11s 1d to £17 12s 4d. Reductions in the prices of valves range, according to type, from 2s to 9s (inclusive of tax) or by 10 per cent to 33 per cent. These are reductions in prices of current valves and tubes bought by the public for replacement purposes and therefore will not necessarily affect the prices of television and radio sets. These are the first changes in retail prices since 1950 and have been made possible by economies resulting from the extensive capital expenditure on plant made in recent years. Such economies can be applied only to modern types; since the cost of production of old types continues to rise their prices cannot be reduced and may even have to be increased.

Engineer Awarded £5,175

An assistant section engineer, Mr. J. B. McMillan (28), of Staythorpe, was awarded £5,175 damages at Nottingham Assizes recently in an action against the Central Electricity Authority.

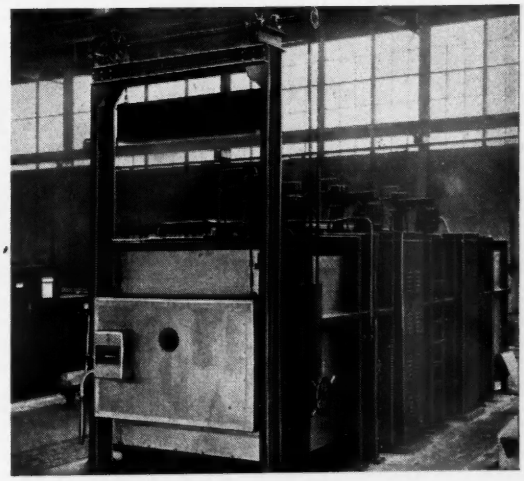
Mr. W. A. Fearnley-Whittingstall, Q.C., for the plaintiff, said that on 26th July, 1952, he received a report that a grid transformer near Warwick was showing signs of overheating and the next day he visited the transformer, climbing a ladder to see the fault. Owing to negligence by the defendants, part of the equipment that ought to have been "dead" became "alive" and he received a shock of about 18,000 V. In consequence 17 per cent of his body was charred and he suffered excruciating agony month after month. Over a period of three years he had had seven grafting operations. Since his discharge from hospital he had returned to work but could not carry out the same class of work, nor could he take part in the recreations he had previously enjoyed.

Mr. A. P. Marshall, Q.C., for the C.E.A., admitted negligence on the part of the servants of the Authority. Plaintiff, he said, was still employed as an assistant section engineer, at a salary higher than at the time of the accident.

Mr. T. A. Clarke, a section engineer, said that since the accident Mr. McMillan had satisfactorily discharged his duties and he could see no reason why he should not be promoted. This view was also expressed in evidence given by Mr. J. Pearce, transmission engineer.

British Furnace for Holland

A large contract has just been completed by G.W.B. Furnaces, Ltd., of Dudley, for the Koninlijke Nederlandsche Staalfabrieken v.h. J. M. de Muinck Keizer N.V. (DEMKA), Holland, for an electric furnace for annealing, hardening and tempering steel bars. The furnace is of the batch type and is used for heat-treating carbon and low-alloy steel bars up to 21ft 0in, the diameter of the bars varying from ¾in to 6in; the maximum charge weight is 5 tons and loading is effected by means of a Gibbons-van Marle charging machine.



G.W.B. furnace in Demka Steelworks, Holland

Wolf Electric Tools in Australia

Australian production of "Wolf Cub" home constructor portable electric tools has now commenced at the factory of Wolf Electric Tools (Australia) Pty., Ltd., Homebush, New South Wales, and first supplies were released for sale on 1st July. Although at present the drills are being assembled largely from components shipped by the British operating company, Wolf Electric Tools, Ltd., use is already being made of the products of Australian industry. It is anticipated that the use of Australian com-

ponents will increase rapidly until, in due course, the Cub drill will be of 100 per cent Australian manufacture. The marketing of the Australian "Wolf Cub," in common with all other Wolf products, is in the hands of Wolf Sales Pty., Ltd., Consol House, 122/124, Sussex Street, Sydney, New South Wales.

Next Week's Events

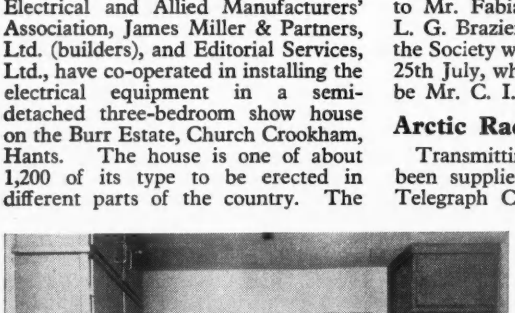
With the approach of the holiday season most of the electrical institutions have completed their sessional programmes. There are, however, two events next week which readers should note. These are the annual meeting of the Electrical Industries Benevolent Association, which is being held next Thursday (12th July, 11.30 a.m.) at the C.M.A. Offices, High Holborn House, 52-54, High Holborn, London, W.C.1, and a district meeting of the Southern Centre of the I.E.E., which will be held on the same day (6.30 p.m.) at Ryde Castle Hotel, Ryde, I.o.W., when Mr. G. G. MacNeice's paper on "The Recent Search for and Salvage of the Comet Aircraft near Elba" will be read.

Copper Price Reduced

The price of copper from the Roan Antelope and Mulufira mines of the Rhodesian Selection Trust has been reduced (as from Monday last) from £300 to £275 a long ton, c.i.f., for electrolytic wirebars.

Electrically Equipped Show House

Member companies of the British Electrical and Allied Manufacturers' Association, James Miller & Partners, Ltd. (builders), and Editorial Services, Ltd., have co-operated in installing the electrical equipment in a semi-detached three-bedroom show house on the Burr Estate, Church Crookham, Hants. The house is one of about 1,200 of its type to be erected in different parts of the country. The accompanying picture shows the kitchen, which is fitted with an electric cooker (Belling), refrigerator (Electrolux), washing machine (Hoover), food mixer (English Electric), water storage heater (Berry's) and kettle (Best Products).



The kitchen of the show house on the Burr Estate, Church Crookham, Hants

Cheaper Vehicle Lamps

Members of the Electric Lamp Manufacturers' Association announce reductions in the price of commercial vehicle and bus interior lamps as from 1st July. Most of these lamps are of the 24V type, with the exception of a 12V double filament pre-focus lamp. The reductions range from 2d to 7d.

New High-Temperature Alloy

Reuter reports that the Westinghouse Electric Co. has developed a new alloy "Nivco" composed mainly of nickel and cobalt which is capable of withstanding temperatures up to 1,200 deg. F. It is to be used for steam turbine blading but may also be adapted for use in jet engines.

Batti-Wallahs' Society

Some of the methods of crime detection employed by Scotland Yard were revealed by Mr. R. Fabian, known to many for his broadcasts and his books as "Fabian of the Yard," at last week's luncheon of the Batti-Wallahs' Society. Mr. Fabian showed how the flimsiest of clues could lead to the arrest of the evil-doer. He also indicated that he was an opponent of the abolition of capital punishment, prophesying an increase in crimes of violence if this should come about. Mr. W. C. M. Couch (president) presided at the luncheon, and a vote of thanks to Mr. Fabian was proposed by Dr. L. G. Brazier. The next luncheon of the Society will be held on Wednesday, 25th July, when the guest speaker will be Mr. C. I. Coughrey.

Arctic Radio Stations

Transmitting equipment has recently been supplied by Marconi's Wireless Telegraph Co., Ltd., for three radio stations which are to be built in Greenland. One station is to be used for ground-to-air communications on the transatlantic and the trans-polar air routes from Europe to North America, while the remaining two will serve a new trans-polar route from Scandinavia to Tokyo.

The contract called for six medium-power high-frequency channelised communications transmitters, Type HC.205, together with drive units, remote control and aerial matching equipments. Two Marconi engineers will be responsible for the installation work. Despite keen American competition, the order was secured for Britain through the company's agents in Denmark, Sophus Berendsen A/S; the purchasers are the Royal Greenland Trade Department.

One station is to be installed at the present weather station Nord—the northernmost radio station in the world, less than 600 miles from the Pole. This station can only be reached by air, normally from the air base near Dundas, the second station, which is situated on the north-west coast. The third station is Prins Christiansund, near the southern tip of Greenland.

Each station will have a dual installation of Type HC.205 transmitters, one as standby, to be operated by remote control. A transmitter of this type is designed to radiate up to three simultaneous telegraph or telephone transmissions on separate crystal-controlled channels.

Catalogues Required

Colt Ventilation, Ltd., Surbiton, Surrey, state that they are reorganising their technical library and would like to be supplied with up-to-date books, catalogues, trade publications and other data.

Edinburgh Trades Holiday

The works of Bruce Peebles & Co., Ltd., will close this evening, 6th July, and reopen on Monday, 23rd July.

Changes of Name

Emmerson and Stephenson (Electrical Contractors), Ltd., have changed their name to Emmersons (Chester-le-Street), Ltd.

The name of H. Fisher (Oldham), Ltd., has been changed to Creston Electric, Ltd.

Change of Address

The address of the Institute of Metals is now 17, Belgrave Square, London, S.W.1 (telephone: Belgravia 3291). Correspondence for the Joint Library and Information Department should be addressed to 4, Grosvenor Gardens, London, S.W.1 (telephone: Sloane 0061, Ex. 2).

Trade Announcements

Bill Switchgear, Ltd., are opening a branch office and stores at 23, Bedford Street, Belfast (telephone: Belfast 20398), under the managership of Mr. J. Ballentine.

Wilkins & Mitchell, Ltd., have made the following appointments of depot managers in the "Servis" washer Service Departments:—Edinburgh, Mr. G. Blanch; Nottingham, Mr. F. Walker; Dundee, Mr. B. Norris.

The Accounts Department of **Truvox, Ltd.,** has been transferred from the Wembley factory to the company's new premises at 15, Lyon Road, Harrow, Middlesex (telephone: Harrow 9282).

INDUSTRY AND THE HOUSE

Investment Allowances to Encourage Exports

By A. M. F. PALMER, A.M.I.E.E., M.P.

MUCH of the time of honourable Members has been occupied recently by the long and on occasion, if the truth be told, tedious discussions of the Finance Bill Committee Stage, which must be taken on the floor of the House. However, I am afraid that the population of the chamber at any given moment depends very much on the interest or otherwise of the amendment under discussion.

Mr. Hobson, Labour Member for Keighley, moved an amendment to retain investment allowances for the machine tool industry because of increasingly keen competition from its rivals in the United States, Switzerland and Western Germany. Mr. Albu, in support, said that as a basic need for every manufacturing industry the capacity of the British machine tool industry was completely inadequate. In the first two months of this year United Kingdom imports of machine tools had exceeded exports, which meant that capital goods of steel had been imported in order to make consumer goods.

Sir Edward Boyle, Economic Secretary to the Treasury, on behalf of the Chancellor, thought a strong case had been made out for the amendment. Although they had considered it carefully he regretted they had come to the conclusion that this year it was not possible to go beyond the three categories of shipping, scientific research and fuel saving.

"Selective Control"

A general amendment in the same field was moved by Mr. Albu; this sought to give the Government authority to retain the investment allowance in any industry where "it would increase exports, save imports, promote technical development or the better use of national resources." Mr. Albu argued that while there might be a case for restriction of investment in some industries, it was equally necessary that others should be stimulated. In any case the Government, he thought, would be forced by the economic facts of life to accept stronger controls in the near future.

In support Mr. Douglas Jay, one of Labour's former junior finance Ministers, referred to reports that the Government was contemplating a return to some kind of "selective control." If so, the Opposition agreed it would be a mistake to take refuge once again in indiscriminate investment cuts to correct the balance of payments. Sir Edward Boyle successfully asked the House to reject this amendment; whatever was the right solution for managing investment in the economy, the Government could not accept that tax inducement was the wise way.

Later the Economic Secretary to the Treasury gave some figures of United Kingdom investment. He thought it wrong to be too pessimistic about the country's achievements. The proportion of domestic fixed investment to the gross national product had risen from 10.3 in 1946 to 14.4 in 1950 and to 16.7 in 1955. These figures included depreciation. Inaccurate comparisons with other European countries often seemed to show British performance in a bad light, but Sir Edward thought it worth noting that over the period 1948-54 United Kingdom fixed domestic investment as a percentage of gross national product at market prices was 13 per cent; this was against 16 per cent for the United States during the same time.

Controversial issues affecting the nationalised industries are still much to the fore. I refer to the decision to appoint a Select Committee for Nationalised Industries with broader terms of reference than before; to the rather bashful declarations from first electricity, then coal and now gas that prices will be stabilised; and to the financing of State industries direct from Treasury advances. This last point raised a row in the small hours of a Wednesday morning, after a further nocturnal discussion of the Finance Bill. Viscount Hinchingbrooke, Mr. Maude and Mr. Nabarro, all Conservatives, complained that the policy of Mr. Macmillan contained two major errors. First that the taxpayer was being made to find the capital requirements of the nationalised industries, and secondly that they were being brought more and more under the umbrella of the State, establishing a trend which it would be difficult to reverse.

Mr. Harold Wilson, for the Opposition, welcomed the new procedure as being simpler and more direct, and Mr. Macmillan defended it by emphasising that the change was only "technical." It would have no effect whatsoever, he said, on control by the Minister or the Treasury of the capital schemes for nationalised industries, and made no change in interest rates. The old system of frequent market issues by the Boards under Treasury guarantee—often at inconvenient times—had prejudiced the general Government programme of re-financing and funding. Since the Exchequer, in present circumstances, would in any case have to bear the burden of providing the bulk of the capital, he thought it better that it should be from the start in control of the whole operation.

In spite of this authoritative explanation, I shall be surprised if the Government dissentients are really satisfied. The Coal Industry (Borrowing Powers) Bill has yet to meet its Committee stage; when it does I am sure we shall hear more of the matter.

Technical Training

The debate on technical education did not attract a large attendance. At times only those who had spoken or were anxious to speak occupied the benches. A number of interesting points emerged from a discussion which took a very routine course. Sir David Eccles, the Minister of Education, announced that he proposed to designate as colleges of advanced technology: Birmingham, Bradford, Cardiff, Loughborough, Salford, together with the Battersea, Chelsea and Northampton Polytechnics in London. These eight, Sir David said, were, however, provisional selections. He had to satisfy himself that if they did not already fulfil the necessary conditions, they would do so in the very near future. In the Tyneside and Tees-side area one of the present Regional Colleges would be a college of advanced technology, but he could not contemplate more than one for the present. He was asking the local education authorities concerned to confer and consult with industry and advise him in making a decision. In the south-west no college was yet far enough ahead to be designated, but he had the Bristol College of Technology in mind if enough support was forthcoming from

local industry. Altogether this would mean ten advanced colleges; for the time being the Government thought there would be difficulty in staffing them at the high scientific and engineering level expected.

Mr. Butler (it should be remembered he is not only the previous Chancellor of the Exchequer, but a former Minister of Education), in replying to the debate, gave his answer to some of the adverse comparative figures—in relation to other countries—of the output of scientific and engineering graduates. He said that, in terms of pure science graduates per million of the population the British figure for 1954 was 105; for Western Europe it was only 48; the Russian figure was 56. In the United States it was 144, but he would not guarantee that the average quality of a large proportion of American graduates was quite up to the standard expected here. In technology Mr. Butler argued that foreign figures included as graduates many who would in this country take, say, Higher National Certificates at technical colleges at the same level. It was difficult in these things to compare like with like.

Mr. Butler also said that the universities had been asked to put forward technological building schemes to start after March, 1957, when the present capital programme expired. He thought we could then look forward to a rise in student numbers of 60 per cent in the next five years, an average increase of 12 per cent per year. "This is really business!" exclaimed Mr. Butler. On that exultant note the debate concluded, yet the Opposition is still unconvinced that sufficient progress is really being made in the field of technical education and training.

PARLIAMENTARY REPORT

A CUT of £2,295,000 in expenditure on the Ministry of Fuel and Power's "special services" was among the economies mentioned by the Chancellor of the Exchequer, Mr. Harold Macmillan, when he announced a reduction of £76 million in Government expenditure in the current year. In a written statement he indicated that the savings on special services at the Ministry of Fuel and Power would be achieved by "economies in capital expenditure on oil installations and in civil defence measures in the gas and electricity industries." A further reduction of £160,000 in the Ministry's civil vote will be achieved by administrative economies. The Chancellor said that he was making an interim report on the Government's review of all Government expenditure, the object being, as he stated in his Budget speech, to reach savings amounting to £100 million in the current year.

Reactor Exports

Replying to Mr. Airey Neave, the Lord Privy Seal, Mr. Butler, said the Government was fully alive to the importance of the export of nuclear reactors and components by British industry. The immediate opportunities lay in the export of research reactors, for which some orders had already been secured, but the progress made in the application of nuclear energy to the production of power should put British industry in a good position to compete for export business in power reactors.

Mr. Neave asked if agreements had been made with Commonwealth countries for the sale of nuclear reactors and other plant.

Mr. Butler said that one British firm was now constructing a research reactor in Australia. Of course, the sale of reactors was a commercial matter for the manufacturers concerned.

Mr. Chetwynd asked if there could be an agreement whereby the U.S.A. provided the fuel and we provided the machinery; unless the two went together Britain would be at a great disadvantage.

Mr. Butler said he could only refer Mr. Chetwynd to the agreements which had already been made with the U.S.A.

Sir James Hutchinson asked the Lord Privy Seal from where any fissile material for reactors sold to the Federal Republic of Germany would be supplied and what would be its nature, and where the reactors to be sold to Germany were to be manufactured.

Mr. R. A. Butler said that a provisional order had been placed with a British firm for a small research reactor of the swimming-pool type, but this was subject to an agreement being reached between the United Kingdom and the Federal Republic covering the supply of fissile material and the reprocessing of spent fuel elements. If this agreement was concluded and the order was placed the reactor would be manufactured by the firm concerned and the fissile material, in the form of manufactured fuel elements, would be supplied by the Atomic Energy Authority. The material would be uranium enriched up to a maximum of 20 per cent U235.

Policy on Electricity Prices

Referring to the decision of the electricity supply industry to refrain from raising prices in spite of the increased coal charges, Mr. Palmer asked the Prime Minister if he was aware that electricity was already one of the cheapest things available in this country compared with pre-war, and that this decision might possibly risk the financial stability of the industry. "Is it fair," he asked, "that any nationalised industry should have commercial decisions imposed on it by Ministerial influence while free enterprise industries are, apparently, to be free of control?"

Sir Anthony Eden: "I do not think this does an injustice to anyone. There are other questions down about the position of the Electricity Boards. They have the necessary finances to enable them to take action, and they have decided to take it. I think we should welcome it."

Mr. J. Harrison asked the Prime Minister if he was aware that the acceptance of the Government's request to nationalised industries to "freeze" prices had resulted in official disclosures that certain Boards were bound to be involved in deficits and, in view of the fact that the nationalised industries' stocks were, in general, guaranteed by the Treasury, if he would make a statement of Government policy in this regard.

Sir Anthony Eden replied that while some of the Area Boards might be in deficit, the electricity industry as a whole was expected to make a small surplus. This would fully satisfy the statutory requirement that the combined revenues of the C.E.A. and the Area Boards taken together should be sufficient to meet their combined outgoings taking one year with another.

Guards for Gas and Electric Fires

In reply to Mrs. Lena Jeger, Mr. Renton, Parliamentary Secretary, Ministry of Fuel and Power, said it was true that accidents continued to occur where old and unguarded gas and electric fires were in use. The Minister was informed that Gas and Electricity Boards held stocks of guards suitable for most unguarded fires in use and that their showroom and other staffs were instructed to draw the attention of users to the importance of fixing guards. The Minister therefore did not consider that a general direction was necessary.

Nuclear Nomenclature

Mr. Airey Neave asked the Lord Privy Seal whether he was aware of the need to introduce a uniform nomenclature of equipment used in nuclear research and industrial development of nuclear energy.

Mr. Butler said an expert committee of the British Standards Institution, assisted by the Atomic Energy Authority, was engaged in the preparation of a uniform nomenclature covering nuclear science and equipment. He could not say when it would be published. The Government was also giving its support to a programme which had been drawn up by the Organisation for European Economic Co-operation for establishing a uniform nomenclature among its member countries.

Exports to Argentina

Mr. P. Thorneycroft, President of the Board of Trade, stated that United Kingdom exports to Argentina in 1955 —amounting to nearly £23½ million— included engineering products worth £8,426,000.

Purchase Tax

In the final stages of the committee discussion on the Finance Bill, the Opposition sought to reduce the rates of purchase tax from 90 to 75 per cent, from 60 to 50 per cent, 30 to 20 per cent and the lower rates from 10 and 5 per cent to one quarter of 1 per cent.

Mr. Albu explained that the object was to abolish the lower rates altogether but under the rules of the House he could only ask for them to be reduced. He said that these rates were really a sales tax on essential goods and had the effect of putting up the cost of living.

Mr. Frank Tomney spoke of the bad effects of the higher rates of purchase tax on the motor car and engineering industries. He said they had valuable export markets to explore but they could not do this unless there was a stable home demand and a lower level of "this penal tax."

Mr. Chapman said there should be flexibility in the use of the tax so that more products should be allowed on the home market when they were piling up and people were being put on to short-time working.

Sir Edward Boyle, Economic Secretary, speaking for the Government, said that to make reductions of this kind would upset the whole plan of the Budget. Members frequently complained that it was disturbing to industry to have the rates continually changing. The Government had another instrument, the hire purchase regulations, which could be used more flexibly and, whenever it was suitable and appropriate, the Government would not hesitate to use it.

During the first five months of this year the value of imports was 1½ per cent higher than in the same period of last year, and the value of exports had gone up 6 per cent. It was not without significance that home consumption was running at almost the same level as last year, though there was a considerable falling off in demand for durable consumer goods. Against this, it looked as though private industrial companies would invest 17 per cent more than last year. In other words, exports were going up substantially faster than imports, and productive investment was rising much faster than consumption. By any standards, these were fairly satisfactory indicators of the economy. The Government believed that the increases in purchase tax had contributed to this.

Mr. Douglas Jay pointed out that the revenue which the Chancellor proposed to raise from the tax this year was £510 million. The tax had risen by £200 million in the last two years and it now amounted to almost as much as the total income tax revenue from schedule E.

The Opposition amendments were negatived by 203 votes to 155.

Price Agreements Defended

Lord Gridley, speaking in the second reading debate on the Restrictive Trade Practices Bill in the House of Lords, defended the price agreements which had been used in the electrical and mechanical manufacturing industry. He said he had been engaged in this industry for nearly 60 years and he did not think anything they had done in the question of prices had been detrimental to the national interest, especially when many firms did not join a trade association and were free to quote what price they liked. Many times he found his firm underquoted by those who were desperately anxious to get a contract. It was not sufficiently borne in mind that, more often than not, it was better to pay a higher price for an article which was robust and durable than to pay a lower price for an article which was inferior.

People in his industry could never forget that electricity was really a lethal weapon. Wherever it was used most careful precautions had to be taken. The material used, the quality of insulation that was part of a machine, and the wiring of houses—all these had to be of the highest quality so that those who worked the machines, and people at home, could feel that they were entirely free from the risk of accidents. It could be claimed, certainly in the last 20 years during which price agreements had been operative, that the most amazing progress had been made in the science, technical knowledge and practice of the electrical industry—progress which would never have been possible without the co-operative arrangements that were made through the association. That being so, the arrangement must be approved as being in the national interest, and not against it.

With the birth of two new industries, electronics and nuclear power, vast potentialities had to be explored. These industries, like the radio industry, would be to a large extent in partnership with the electrical industry. The House must be careful not to do anything which would impair the value of the co-operative methods which had been carried on, because unless progress was made in development, technical advances and the production of high-class goods, Britain would fall behind her competitors. These industries had wide opportunities for increasing exports, and had now in their hands a chance whose loss the nation would bitterly rue unless they grasped it—for there was no doubt that the industry was feeling the increasing competition of other countries.

He hoped it would be possible to make some provision in the Bill for a revision of its terms and conditions should economic circumstances worsen and a considerable amount of unemployment arise. It would then become an urgent matter to re-examine whether some of the restrictions which had been imposed by the courts could be lifted and industry allowed to resume its arrangements to the benefit of employees and in the national interest.

Contracts for Kariba Project

In the Commons the Secretary of State for the Colonies was asked what proportion of the financial contribution to be made to the Kariba Hydro-Electric Scheme was to be borne by the Colonial Development Corporation.

Mr Hare, Minister of State, Colonial Office, said that the Colonial Development Corporation had been authorised to lend £15 million, which would represent about 19 per cent of the cost of the first stage of the project.

Sir R. Jennings asked if the Italians had got the contract for carrying out this scheme. If this was so, was it not right that the House should see that British money was spent in developing British industries rather than Italian industries?

Mr. Hare said that the Government had been in consultation with the Federal authorities and was satisfied that the arrangements made for United Kingdom contractors were fair ones in competing for this new business.

Mr. Stokes: "Is it a fact that, despite the greater part of the money for the Kariba scheme being provided by the United Kingdom, the main contract for £20 million has already been let to the Italians?"

Mr. Hare explained that he was not in a position to answer any questions about the letting of contracts.

A.C. Railway Electrification

Mr. Geoffrey Wilson asked the Minister of Transport whether he had made a definite decision on the system of electrification to be used on British Railways.

Mr. Watkinson replied that he had approved the British Transport Commission's proposal to adopt the 50 c/s system, with overhead supply, as a general standard for the future electrification of British Railways, except where electrification was being extended in certain parts of the Southern Region.

PERSONAL AND SOCIAL

News of Men and Women in the Industry

The Electrical Association for Women announces the resignation of its director, **Dame Caroline Haslett,** D.B.E., J.P., Companion I.E.E., from 31st July. Illness has caused her withdrawal from public life for the past two years, but as honorary adviser she will continue with the Association which she has directed since its inception 32 years ago.

Dame Caroline's name will always be linked with the development of the domestic uses of electricity. Her association with the technical world

Dame Caroline Haslett

Miss Norah Balls

began in a Scottish boiler factory in the 1914-1918 war and she became the first secretary of the Women's Engineering Society in 1919. She was made a Companion of the Institution of Electrical Engineers in 1932 and was the only woman appointed a member of the newly created British Electricity Authority in 1947. She was the first woman chairman of the British Electrical Development Association, and has been a member of the British delegation to the World Power Conference on several occasions.

Outside the electrical industry, she has served on the Councils of the British Institute of Management, the Industrial Welfare Society and other organisations and on the governing bodies of a number of schools. She was chairman and later president of the British Federation of Business and Professional Women, and first British woman to be elected president of the International Federation of Business and Professional Women. During the last war she was Adviser on Women's Training to the Ministry of Labour and remained a member of the Ministry's Women's Consultative Council. She was a member of the Crawley Development Corporation, and has served on numerous technical committees. She went on several wartime Government missions abroad, to the U.S.A. and Canada, to Sweden and Finland, and to the British Forces in the Middle East. After the war she took a leading part in conferences of women organised by the British and American authorities in Germany. Dame Caroline is now making her home in Suffolk.

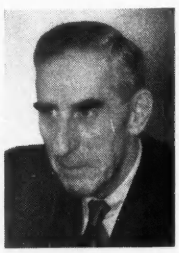
Miss Norah Balls, J.P., chairman of the National Executive Committee, at the request of her fellow committee members, has consented to undertake in an honorary capacity the office of acting director/secretary pending the appointment of a successor to Dame Caroline. Miss Balls is well known for her public work in the north of England, and especially among the E.A.W. branches throughout the country.

New members of the Merseyside & North Wales Electricity Consultative Council include **Mr. T. E. Houghton,** M.Eng., M.I.C.E., M.I.Mech.E., M.I.E.E., of Warrington. **Mr. E. J. Evans,** M.Sc., M.I.E.E., M.I. Mech. E., A.M.I.C.E., of Port Sunlight, has ceased to be a member of the Council.

Mr. H. Payne, district commercial manager at Pontypool, of the South Wales Electricity Board, has retired. Mr. Payne commenced his career with the former South Wales Power Co. in 1908. Before nationalisation he was the district manager of the South Wales Power Co., for Pontypool, a post which he had held since 1931. Mr. Payne will be succeeded as district commercial manager by **Mr. W. L. Sambrook,** who has been his senior assistant at Pontypool since 1941.

Morphy-Richards, Ltd., announce the appointment of **Mr. R. M. Morgan** as home sales manager. He joined the company before the war and after serving in the R.A.F. was appointed northern representative. He later transferred to the London and Home Counties area and subsequently took charge of the home sales office.

Mr. A. A. Nimmo, A.M.I.E.E., who has just retired after forty-nine years' service in the electrical industry, was born in 1891 and was educated at the Royal Technical College, Glasgow. He served his apprenticeship with L. Stern and Co., Ltd., in Glasgow and joined the staff of Mavor and Coulson, Ltd., in 1911, leaving them during the 1914-18 war when he served as a lieutenant in the South Lancashire Regiment. Up to 1921 he was employed in the contract department of British Insulated Cables, and he then went to the Newcastle-on-Tyne Electric Supply Co., with which company he spent two years. From 1925 until nationalisation Mr. Nimmo was with Bedford Corporation and at the time of his retirement last month, he was engineer to the Bedford District of the Eastern Electricity Board. Mr. Nimmo has been an active member of the E.P.E.A.



Mr. A. A. Nimmo

The Secretary of State for Scotland has appointed **Mr. A. Duncan Millar,** Remony, Aberfeldy, to be a member of the North of Scotland Hydro-Electric Board for the period until 31st December, 1958. Mr. Millar was formerly a member of the firm of Sir Alexander Gibb & Partners. He worked as an engineer on the Galloway Hydro-Electric Scheme and was the firm's resident engineer at the North of Scotland Board's Pitlochry power station. He is now a farmer and estate owner.

Mr. H. Murphy has joined the board of the Kenwood Manufacturing Co., Ltd., as sales director. Shortly after the war, he joined the Prestige Group, Ltd., as demonstration manager, becoming sales promotion manager, divisional sales manager and finally home sales manager. He was also a director of Champion (Mexborough), Ltd., a subsidiary of the Prestige Group, Ltd.

Mr. H. Murphy

At the meeting of the Council of the Public Transport Association held on 14th June, **Mr. J. M. Birch** was re-elected for a second year of office. **Mr. T. R. Williams** and **Mr. P. G. S. Clark** were also re-elected as vice-chairmen for the ensuing year.

Mr. R. L. Evans, A.M.I.E.E., has been appointed senior assistant to the sub-area commercial officer at Wolverhampton, and takes up his new duties on 1st July. Mr. Evans has, for the last three years, been district engineer in the Dean Forest District of the Midlands Electricity Board.

Mr. W. T. Cooper, who has been editor of the *Journal* and other publications of the Institute of Fuel since 1948, is resigning at the end of July to take an appointment as senior research officer, Australian Commonwealth Scientific and Industrial Research Organisation. Mr. Cooper will be in charge of information and public relations work in the Coal Research Section of S.C.I.R.O. at North Ryde, Sydney, N.S.W. He is to suc-

ceed Mr. **N. Y. Kirov** as hon. secretary of the Australian membership of the Institute of Fuel in January, 1957.

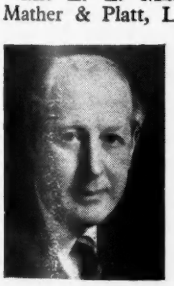
The Midlands Electricity Board has appointed **Miss Dorothy Taylor** to succeed Miss Edith Lockley, whose retirement from the position of chief demonstrator, previously announced, took effect on 3rd July. Miss Taylor has been appointed as a principal assistant in the commercial department at Board headquarters at Mucklow Hill, Halesowen, with responsibility for service to consumers in housecraft and the use of domestic electrical equipment and for the training and supervision of the Board's staff of upwards of 90 demonstrators. She has had 24 years' experience in the electricity supply industry, including service with the West Hartlepool, Cheltenham, Luton and Watford electricity undertakings. In 1948 she was appointed senior housecraft adviser in the Chilterns subarea of the Eastern Electricity Board.

Miss D. Taylor

Miss Taylor won the Caroline Haslett Travelling Scholarship in 1948 and spent three and a half months in Canada.

Sir Richard Yeabsley, C.B.E., F.C.A., F.S.A.A., has been appointed deputy chairman of F. Perkins, Ltd. He succeeds **Capt. A. J. M. Richardson,** deputy chairman since 1944, who has resigned owing to pressure of other business. Sir Richard joined the board of the company in 1951. **Mr. M. I. Prichard** is appointed deputy managing director. He joined the company at the end of 1953 as personal assistant to Mr. F. Perkins, chairman and managing director, and became director in charge of engineering the following year.

Mr. L. E. Mather, chairman of Mather & Platt, Ltd., was presented with a portrait of himself on 27th June, painted by Edward Halliday, R.B.A., at the company's main works in Manchester. The ceremony marked the fortieth anniversary of Mr. Mather as chairman of the board, and the portrait was subscribed for by thousands of the company's past and present employees both at home and abroad. The presentation was made by Mr. T. Y. Sherwell, the senior director of the company, before a large audience from works and offices. Mr. Mather became a director of the company in 1908, and on the retirement of his father, Sir William Mather, P.C., LL.D., in 1916 he assumed the chairmanship. He was appointed a C.B.E. for his services as regional controller, Ministry of Production, from 1942 until 1945; he is vice-chairman of the North-Western Regional Board for Industry, and was one of the founders of the Manchester Engineering Council in 1918, being its president for fourteen years.

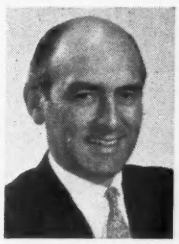


Mr. L. E. Mather

Siemens Brothers & Co., Ltd., has appointed **Mr. J. A. E. Trinder** as its London area manager with effect from 1st June, and **Mr. B. N. Dunster,** M.I.E.E., as deputy area manager, London sales.

Mr. Trinder will be responsible for London area sales and will, in addition, control the Reading, Ipswich and Southampton sub-branches of the company. He was previously home sales manager of Siemens Electric Lamps & Supplies, Ltd., which he joined in 1953 and before that was Ekco-Ensign representative in Bristol and the West of England.

Mr. Dunster joined Siemens Electric Lamps & Supplies, Ltd., in 1938 and was appointed sales manager, London and Home Counties, with that company in 1941. He was previously technical assistant to a consulting electrical engineer.



Mr. J. A. E. Trinder

Mr. B. N. Dunster

Mr. W. S. Fowlie, M.I.E.E., has been appointed manager of the North of Scotland Hydro-Electric Board's Northern Area, which includes Caithness and Sutherland and parts of the counties of Ross and Inverness. Since 1954 Mr. Fowlie has been assistant area manager in the Board's North Caledonia Area. Mr. Fowlie received his training with the Aberdeen Corporation Electricity Department. Subsequently he was employed as test engineer with Barking Corporation, as distribution superintendent with the Perak River Hydro-Electric Co., Malaya, and as operation and maintenance engineer, Essex, with the Eastern Electricity Board.

Mr. E. G. Ball has been appointed station superintendent of Wakefield "B" power station, Yorkshire Division, C.E.A. Educated at the Walker Technical College, Oakengate, Salop, and Wolverhampton Technical College, Mr. Ball served his apprenticeship with the Liverpool Refrigeration Co. He entered the electricity supply industry in 1935, holding various positions in power stations at Ironbridge, Ocker Hill and Meaford where he was appointed deputy station superintendent in 1951. In 1953 he became station superintendent of Barugh, Barsley and Wakefield "A" power stations.

Mr. H. Finch has been appointed managing director of Volex Electrical Products, Ltd., Salford. He joined the company on its formation as sales development manager, and was appointed to the board in 1954.

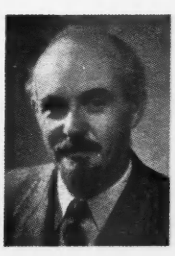
Mr. H. Finch

Mr. John Lewis, the South Wales Electricity Board's district commercial manage for Ammanford and Brynamman, has retired after forty-six years' service in the electricity supply industry in that area. He was appointed engineer and manager of the Brynamman and District Electric Supply Co. in 1915 and when that company was taken over by the South Wales Electric Power Co. in 1937 he became district manager there, a position he held until nationalisation in 1948.

The Board has decided to amalgamate the Commercial Departments previously centred at Ammanford and Ystradgynlais and the present district commercial manager at Ystradgynlais, **Mr. J. Phillips,** J.P., has been appointed district commercial manager for the combined area, which embraces Ammanford, Brynamman, Pontardawe and Ystradgynlais.

Mr. A. Rose has joined the British Central Electrical Co., Ltd., as manager of the Plant Department. Mr. Rose was previously with the London County Council and the London Electricity Board.

Mr. A. Rose



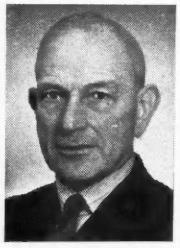
Mr. D. Clark

Mr. D. Clark, chief electrical and lighting engineer to the Ilford Borough Council, is taking up a similar post early this month with the City of Norwich.

The **Dowty Group, Ltd.,** recently held its silver jubilee luncheon at Arle Court, Cheltenham, at which the chief guest was Mr. R. Maudling, Minister

of Supply, who spoke of the valuable contribution of the group not only to the aircraft industry but to the industry of the country as a whole. Mr. G. Dowty, chairman of the Group, presided, and in responding to the toast of the Group, spoke of the commencement of its activities in 1931 and of its subsequent growth.

Mr. F. W. Gardner, B.A., A.M.I.C.E., director and general manager of C. A. Parsons & Co., Ltd., retired on 30th June after completing 44 years' service with the company but is retaining his position on the board of directors.



Mr. F. W. Gardner

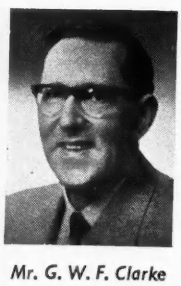
Mr. Gardner was born near Liverpool, and was educated at King's School, Chester, and Queens' College, Cambridge, where he graduated in Mechanical Sciences. He joined C. A. Parsons as a student apprentice in 1912. During the 1914-18 war he held a commission as engineer officer in the Naval Airship Service, becoming a major in the Royal Air Force on its formation in 1918. At the end of the war he returned to the Heaton Works, becoming head of the turbine design staff a year or two later. In 1938, he was appointed chief engineer to the company, in the following year a director and in 1944, general manager. He has visited many overseas countries on behalf of the company, including the U.S.A., Canada and South Africa.

Mr. S. J. Beaney, director and secretary of W. T. Henley's Telegraph Works Co., Ltd., has been elected a director of the Barbados Electric Supply Corporation, Ltd., in the place of the late Sir Montague Hughman.

Mr. P. Huffman has retired from the board of Bakelite, Ltd., and **Mr. W. B. H. Gallwey,** chairman of British Acheson Electrodes, Ltd., has been appointed a director.

Following reorganisation, due to expansion, Thermodare (Gt. Britain) announces that **Mr. N. Mendess** has been appointed London sales manager and **Mr. G. W. F. Clarke,** who recently joined the company from the Eastern Electricity Board, has been appointed development manager.

Mr. N. Mendess



Mr. G. W. F. Clarke

Mr. H. Pryce-Jones, J.P., M.Eng., manager of the Mid-Sussex Area of the South Eastern Electricity Board, has been elected chairman of the Shoreham Harbour Board. A reconstruction and enlargement programme costing £2½ million now approaching completion will enable C.E.A. colliers and other vessels of over twice the present size to use the port.

Associated Electrical Industries, Ltd., announces that **Mr. A. N. E. McHaffie** has retired from the board of A.E.I. The following have been appointed to the board of the Hotpoint Electric Appliance Co., Ltd.: **Mr. H. F. Adams,** director of manufacture, **Mr. D. H. Graham,** director of design, and **Mr. D. T. L. Rettie,** director of marketing.

Mr. Clifford Metcalfe has been appointed managing director of E.M.I. Electronics, Ltd. This company, on behalf of the Electric and Musical Industries Group, will take over the full range of research, development, and manufacture on Government contracts and commercial electronics.

Mr. A. C. Ellis, who has been district manager of the Cardiff office of Metropolitan-Vickers Electrical Co., Ltd., since 1952, has been appointed district manager of the company's Manchester office. Mr. Ellis served his apprenticeship with Metropolitan-Vickers and was for many years at the Manchester office. His appointment, which dates from 1st June, is consequent on the retirement of **Mr. J. B. Hartley,** who will remain in an advisory capacity until the end of September. **Mr. J. S. Hall,** Associate I.E.E., who was recently appointed assistant manager, Cardiff office (*Electrical Review*, 18th May, 1956), succeeds Mr. Ellis as manager.

Mr. A. C. Ellis

Mr. W. F. Russell, A.Amer.I.E.E., is relinquishing his position as manager of the Wolverhampton District of the Midlands Electricity Board at the end of this month. Mr. Russell, who was the first city electrical engineer of Lichfield and had been with the undertaking since its inception in 1926, was transferred to Wolverhampton in 1950. He intends to take up other interests of a private nature.

The **North-East Electrical Club** held a successful Golf Day for its members at Ravensworth Golf Club on 27th June, the arrangements being made by a small committee under the chairmanship of Mr. T. Mitchelson. The H. H. Mullens Cup was won by Mr. E. C. Robinson, who also won outright a tankard presented by the president, Mr. Clifford Byles. The runner-up was Mr. W. Smith and the foursome was won by Mr. T. E. Dellow and Mr. A. E. Fletcher.

Parents' Day of members of the College and School Section of the **Metropolitan-Vickers Electrical Co., Ltd.,** was held on 23rd June, at Trafford Park, about 300 parents attending who were conducted on a tour of the works by their sons. The sections visited included the steam turbine, large electrical machine and transformer shops, foundry, research laboratories, education department and apprentice training school. After tea in the staff canteen, Mr. R. F. Marshall, manager, Education Department, introduced Dr. Willis Jackson, director of research and education, who spoke of the promising future offered by the electrical industry to young men of good general and technological education.

Next Tuesday's luncheon of the **Electrical Industries Club** will be the first Ladies' Luncheon and the guest-speaker will be Miss Rosemary Horstmann who is manager of the women's programmes for Associated Rediffusion. Members of the Club are being asked whether they are in favour of holding a golf day in September.

The annual treasure hunt of the **Exeter Electric Club** took place on 20th June. Twenty cars entered for this event, and the Peters' Cup was won by Mr. D. Rupp and his crew. Mr. W. Priddle and crew and Mr. A. J. Record and crew tied for second place, it being finally awarded to Mr. W. Priddle on the toss of a coin. The organisers, Mr. and Mrs. Warman, were thanked by the vice-president, Mr. W. Hallam, and he presented them with small gifts in appreciation of their efforts.

The **Eastern Electricity Board, Northmet Sub-Area,** held its annual sports meeting at "Woodcroft," Winchmore Hill, on 23rd June. Ten clubs contested 29 events and the Hertford District won the inter-club challenge shield for the best performance of the day. Standard Telephones and Cables, Ltd., provided sports gear and its staff acted as track officials.

The golf tournament of the **Aluminium Development Association** took place at the Gerrards Cross Golf Club on 21st June, the chief event being the Horace Clarke Cup match. This was won by Mr. R. Hulme (Warwick Production Co., Ltd., a member of the Almin, Ltd., group). Mr. A. C. Green (Aluminium Wire & Cable Co., Ltd.) and P. M. Parrish (Eyre Smelting Co., Ltd., a member of the Alar, Ltd., group) were placed second and third respectively. Four players drew

in the putting competition and the winner, declared as a result of the draw, was Mr. E. G. Obert (A.D.A. Staff). The foursome was won by Mr. F. J. Latimer (I.C.I., Metals Division) and Mr. R. O. Bearcroft (Aluminium Union, Ltd.). A dinner was held in a marquee in the grounds of the Research Department at Chalfont of the British Aluminium Co., Ltd. The president of the Association, the Hon. Geoffrey Cunliffe, presided and presented the competition prizes.

OBITUARY

Mr. H. E. Midgley.—We report with regret the death on 1st July of Mr. Harold Edward Midgley, M.A. (Cantab.), M.I.C.E., M.I.E.E., M.I.Mech.E., a director of the Brush Group, Ltd., and Newton Bros. (Derby), Ltd. Mr. Midgley was born at Wetherby, Yorks, in 1880 and was educated at Wakefield and Queens' College, Cambridge. After training in the York Electricity Department and with Callender's Cable & Construction Co., Ltd., Erith, he served, from 1903 to 1908, in the Erith Electricity Department as mains engineer and, later, chief engineer. He was then with Fraser & Chalmers as a turbine engineer for ten years, leaving them to take up a similar position with Dick, Kerr & Co. and the English Electric Co., with whom he remained until 1921. He was subsequently chief engineer and manager of the Foundation Co., Ltd. (1921-28) and managing director of Ruths Steam Storage, Ltd. (1928-30). He became vice-chairman of Newton Bros. (Derby) in 1930. Mr. Midgley joined the Brush Electrical Engineering Co., Ltd., in 1934 as chairman and managing director, a post which he relinquished in 1937 while remaining on the board of the company. He retired from executive work in 1945. Mr. Midgley was also a director of the Dammann Ashphalt Co. (chairman), Ruths International Accumulators and the Scott Insulated Wire Co. He was a member of the B.E.A.M.A. Council from 1936 to 1946.

Mr. Midgley leaves a widow and two daughters, to whom we extend our sympathy. The funeral ceremony took place yesterday (Thursday).

Mr. J. E. Mackay.—The death occurred on 30th June of Mr. John Eric Mackay, chief electrical designer of Mavor & Coulson, Ltd., with whom he completed fifty years' service on 9th April of this year. In the first world war he served with the Motor Patrol Section of the Navy and on his return to M. & C. he was appointed assistant electrical designer under the late W. B. Hird, succeeding him as chief electrical designer in 1934.

Mr. J. H. Edwards.—The death occurred on 22nd June at Cranham, Gloucestershire, of Mr. James Herbert Edwards, M.I.E.E.; he was eighty-four. Mr. Edwards, who was born at Pencoed, Glam, was trained at Faraday House and later engaged in the electric lighting of public buildings. He was responsible for the starting-up of a number of small electricity undertakings and subsequently became a director of a number of larger concerns as well. He retired in 1929 from the managing directorship of the Western Electricity Supply Co., Ltd., and its associated companies and in 1937 from the board of the Shropshire, Worcestershire and Staffordshire Electric Power Co. Mr. Edwards was largely responsible for the legislation which resulted in the establishment of the Wessex Electricity Co. in 1927. He became an associate member of the I.E.E. in 1910 and a member in 1913.

Mr. J. S. Plumtree.—The death occurred on 26th June at the age of eighty of Mr. John Stanley Plumtree, A.M.I.E.E., a director of J. S. Plumtree & Son, Ltd. Mr. Plumtree, who was educated at Nottingham High School and was a Fellow of Nottingham University, had been a well-known electrical engineer in High Holborn, London, since 1914 and had been a corporate member of the Institution of Electrical Engineers for over fifty years.

Wills

Mr. A. C. Cramb, M.I.E.E., M.I.Mech.E., chief engineer and manager, Croydon Corporation electricity department, 1904-31, and director and secretary, British Electrical Development Association, 1931-43, who died on 10th February last, left £18,874 gross (£18,059 net).

Sir Ernest Montague Hughman, for many years chairman of W. T. Henley's Telegraph Works Co., Ltd., who died on 23rd March, left £71,101 gross (£68,645 net value).

Mrs. L. Willoughby Ellis, of Buxted, Sussex, who died on 26th March, left £8,559 gross (£8,271 net value). Her bequests included £1,000 to the Electrical Industries Benevolent Association "in memory of my husband, H. Willoughby Ellis." Mr. Willoughby Ellis was president of the Electrical Contractors' Association in 1929-30.

I.E.E. PREMIUMS

The Council of the Institution of Electrical Engineers has made the following award of premiums for papers read or accepted for publication during the 1955-56 session:

GROUP A

Institution Premium: T. H. Kinman, M.B.E., G. A. Carrick, M.A., R. G. Hibberd, B.Sc., and A. J. Blundell. *Kelvin Premium:* A. Stott, M.A., and P. E. Axon, O.B.E., Ph.D., M.Sc. *John Hopkinson Premium:* S. S. Carlisle, M.Sc. (Swansea) and G. W. Alderton, B.Sc. (Sheffield).

GROUP B

NON-SECTION PREMIUMS: *Ayrton Premium:* D. Major, B.Sc., B.A., F. R. Perry, M.Sc.Tech., and K. Phillips, M.Sc. *Llewelyn B. Atkinson Premium:* Prof. E. G. Cullwick, O.B.E., M.A., B.Sc. (Dundee).

MEASUREMENT AND CONTROL SECTION.—*Silvanus Thompson Premium:* Lt.-Comdr. F. R. J. Spearman, R.N. (Retd.), J. J. Gait, M.A., B.Sc., A. V. Hemingway, B.Sc.(Eng.), and R. W. Hynes, B.Sc. *Mather Premium:* T. Kilburn, M.A., Ph.D., D.Sc. (Manchester), D. B. G. Edwards, Ph.D., M.Sc. (Manchester) and G. E. Thomas, Ph.D., M.Sc. (Birkenhead). *Extra Premiums:* A. H. M. Arnold, Ph.D., D.Eng., and J. J. Hill, B.Sc., A. B. Gillespie, B.Sc., D. R. Chick, M.Sc., B.Sc., and D. P. R. Petrie, M.Sc.

RADIO AND TELECOMMUNICATION SECTION.—*Duddell Premium:* L. R. F. Harris, M.A. *Ambrose Fleming Premium:* Prof. A. L. Cullen, Ph.D., B.Sc., and J. C. Parr, B.Sc.(Eng.). *Extra Premiums:* E. D. R. Shearman, B.Sc. (Eng.), G. B. B. Chaplin, M.Sc., Ph.D., R. E. Hayes, B.Sc., and A. R. Owens, M.Sc. *Extra Premiums:* R. G. Robertshaw and W. E. Willshaw, M.B.E., M.Sc.Tech., G. H. Metson, M.C., Ph.D., M.Sc., B.Sc.(Eng.), E. F. Rickard, B.Sc., and F. M. Hewlett, B.Sc., W. J. Bray, M.Sc.(Eng.), J. A. Saxton, D.Sc., Ph.D., R. W. White, B.Sc., and G. W. Luscombe, B.Sc.(Eng.).

SUPPLY SECTION.—*Sebastian de Ferranti Premium:* J. S. Mollerhoj, M.Sc., A. M. Morgan, B.Sc.(Eng.), and C. T. W. Sutton, M.Sc.(Eng.). *John Snell Premium:* H. C. Hall, M.Sc., and E. Kelk, M.Sc. *Extra Premiums:* W. G. Standring, M.A., and R. C. Hughes, B.Sc.; D. H. Lucas, B.A., and M. E. Peplow, B.Sc.

UTILISATION SECTION.—*Crompton Premium:* E. L. E. Wheatcroft, M.A., and H. H. C. Barton, B.A. *Swan Premium:* J. J. Bates, Ph.D., Prof. A. Tustin, M.Sc., D. F. Nettell, B.Sc., and R. Solt, B.Sc.(Eng.). *Extra Premium:* Prof. G. H. Rawcliffe, M.A., D.Sc., B. V. Jayawant, B.Eng., and B.C. McDermott, M.Sc.Tech. *Extra Premiums:* T. H. Barton, B.Eng., Ph.D., O. I. Butler, M.Sc., and H. Sterling, B.Sc.; J. C. Read, D.Sc., and C. F. Gimson.

GROUP C

Blumlein-Browne-Willans Premium: R. S. Webley, B.Sc., H. G. Lubszynski, Dr.Ing., and J. A. Lodge, B.Sc. *Fahie Premium:* Capt. C. F. Booth, C.B.E., and B. N. MacLarty, O.B.E. *Heaviside Premium:* I. A. Harris. *Paris Exhibition:* The late T. Lawrie, C.B.E., M.A. *Webber Premium:* W. C. Bain, M.A., B.Sc., Ph.D. *Oversea Premium for Senior Members:* D. B. Reay, D.Sc.(Eng.), B.Sc.(Eng.).

GRADUATE AND STUDENT PREMIUMS.—*Henry Nimmo Premium:* J. H. Denman. *Premiums to the value of* £10 *each:* B. J. Chalmers and A. R. Daniels; G. A. Gibson. *Premiums to the value of* £5 *each:* P. J. Bhatt, B.Sc.(Eng.), C. F. R. Bradshaw, B.Eng., S. G. Griffiths, S. L. Hurst, B.Sc.(Eng.), B. James, B.E., F. H. Steele, B.Sc.(Eng.), and K. T. D. Hughes, and R. J. Weir, B.Eng.

GENERATION AND DEVELOPMENT

Electricity Tariff Stabilisation

Last week we reported that the London, South Wales, Merseyside and North Wales, South Western, East Midlands, South Eastern and Eastern Electricity Boards had intimated their intention to accede to the Central Electricity Authority's request not to increase their charges during the current financial year. Since then the Southern, North Western and Yorkshire Boards have also agreed not to raise their charges. The Eastern, North Western and Yorkshire Boards state that the decision to stabilise charges will mean incurring a deficit in 1956-57 and in the case of the East Midlands Board an adverse balance is "more than likely." The South Wales Board has deferred increases in domestic, farm and commercial block rate tariffs that were to have come into force on 1st July.

Edinburgh and Lothians Reinforcement

The South of Scotland Electricity Board has approved a scheme for the establishment of a new grid substation at Kaimes, near Edinburgh, for reinforcing the supply to the Edinburgh and Lothians areas. The substation will contain two 60 MVA 132/33 kV transformers, tee connected through two 132 kV circuit-breakers to the double-circuit 132 kV line between Portobello and Currie. It is proposed to supply Burghlee, Penicuik and Tranent and the Liberton district of Edinburgh from the new substation, which it is hoped to commission in 1958. The whole scheme (including associated modifications to the distribution network) is estimated to cost £678,000.

A further scheme for reinforcing the supply in West Lothian has also been approved, for completion by 1957, at an estimated cost of £188,000. Two new 33/11 kV substations, supplied from the grid substation at Bathgate, will be erected at Easter Newton and West Calder.

Electricity in Northern Ireland

The twenty-fourth annual report of the Electricity Board for Northern Ireland just published, covering the year up to 31st December, 1955, shows that during the year the sales increased by 9½ per cent compared with the previous year to a total of 422.4 million kWh.

During the year the Board approved rural development schemes estimated to cost more than a million pounds and providing for over 6,000 supplies. New consumers connected numbered 9,514, 6,845 in rural areas. At the end of the year there was a total of 144,230 consumers. With 2,505 farms connected during the year, the number now served is just over 12,700, an increase of some 9,000 during the past five years. The average price per kWh sold for all supplies during the year was 1.78d as compared with 1.75d in 1954.

During the year approximately 500 miles of h.v. overhead lines were constructed made up of 31 miles of 33 kV, 460 miles of 11 kV and the remainder of 6.6 kV transmission.

In the sphere of generation the scheme for the Mourne hydro-electric project was published during the year and this, together with that for the Bann development, is still under consideration by the Ministry of Commerce. Estimates show that both these schemes would be economic and worth while.

The monetary surplus on the year's working after charging interest and sinking fund contributions was £694 compared with £10,999 for 1954. With the continuing increases in wages, costs and materials, and interest rates the Board regards increases in all tariffs as inevitable.

In the Northern Ireland House of Commons on 23rd June the Minister of Commerce (Lord Glentoran) was asked if he was prepared to follow the example of the Central Electricity Authority in pegging the price of electricity in spite of the recent increase in coal costs. He told Mr. N. Porter that electricity charges in Northern Ireland had been governed by the cost of production and distribution and had been kept as low as possible. As a result the undertakings had accumulated no appreciable surpluses. If costs rose substantially, as they had done in recent months, so that continued sales at the present tariff rates would involve the undertakings in serious losses, he would not feel justified in asking them to incur such losses and to borrow the money to meet them.

Finlarrig Power Station

The North of Scotland Hydro-Electric Board's Finlarigg power station, which was officially opened last Saturday by Lady Taylor, accompanied by Sir Thomas Taylor, C.B.E., Principal of Aberdeen University, is equipped with one B.T.H. 35,294 kVA 375 r.p.m. horizontal waterwheel alternator. The station is situated three miles from Killin, the well-known holiday resort in Perthshire, and on the shores of Loch Tay. It is the highest-head station in Great Britain.

Blackpool Illuminations

This year's illuminations at Blackpool, the 24th annual display, will continue for 48 nights from 5th September to 22nd October. Equipment valued at more than £375,000 will be used in this, the largest decorative lighting display in the world, expenditure this year amounting to £86,000. The ceremony of switching on the lights will be televised by the B.B.C. on 5th September.

More than a hundred tableaux and features will be included in the display, the largest of which will exceed 100,000 sq ft in surface area. There will also be over 1,500 floodlights and searchlights, 1,000 pylons and columns of light and 1,000 decorative designs. Electricity consumption will amount to 600,000 kWh for the period, with an off-peak demand of 2,500 kW.

Boards' Sales in May

Details of electricity output and plant capacity in May were given in the *Electrical Review* of 22nd June. The accompanying table, received

ELECTRICITY SENT OUT BY AREA BOARDS FOR THEIR CONSUMERS

Area Board	Totals for May (Million kWh)			Twelve Months Totals Ended May (Million kWh)		
	1955	1956	Inc. or dec. %	1955	1956	Inc. or dec. %
London	484·2	460·2	− 5·0	6,294·8	6,769·0	+ 7·5
South Eastern	302·3	307·3	+ 1·6	3,815·6	4,233·1	+ 10·9
Southern	365·3	378·6	+ 3·6	4,598·3	5,082·2	+ 10·5
South Western	191·0	198·8	+ 4·1	2,380·7	2,598·6	+ 9·2
Eastern	492·0	493·5	+ 0·3	6,161·9	6,741·7	+ 9·4
East Midlands*	435·0	446·5	+ 2·6	5,367·3	5,806·1	+ 8·2
Midlands*	579·4	576·0	− 0·6	7,154·1	7,590·4	+ 6·1
South Wales*	352·2	360·5	+ 2·4	4,125·8	4,419·9	+ 7·1
Merseyside and N. Wales*	344·5	362·6	+ 5·3	4,169·5	4,572·8	+ 9·7
Yorkshire*	570·0	584·6	+ 2·6	6,949·8	7,554·4	+ 8·7
North Eastern*	334·7	345·3	+ 3·2	4,060·1	4,340·7	+ 6·9
North Western*	614·3	627·3	+ 2·1	7,641·0	8,037·0	+ 5·2
Total all Area Boards	5,064·9	5,141·2	+ 1·5	62,718·9	67,745·9	+ 8·0
Direct Supplies by Central Authority	139·9	172·6	+23·4	1,646·5	2,016·5	+22·5
Grand Total	5,204·8	5,313·8	+ 2·1	64,365·4	69,762·4	+ 8·4
Mainly Industrial Areas*	3,230·1	3,302·8	+ 2·3	39,467·6	42,321·3	+ 7·2
Mainly Non-Industrial Areas	1,834·8	1,838·4	+ 0·2	23,251·3	25,424·6	+ 9·3

*Those in which industrial consumers took over 50% of the total sales in the preceding financial year.

from the Central Electricity Authority, analyses the sales of electricity by the twelve Area Boards in England and Wales. The national figures show an increase over May, 1955, of 2.1 per cent, but when corrected for weather conditions and the number of working days (28.15 against 27.83 in May, 1955) the increase is 7.8 per cent.

Tenants' Association's Request Rejected

Solihull Housing Committee has turned down a request from the Borough Tenants' Association that consideration should be given to the question of providing electric cookers in council houses.

The association had suggested that these should be provided by the council, and that tenants should pay a hire charge similar to the scheme operated in respect of prefabricated bungalows.

Mr. Maurice Mel, Town Clerk, said that to install electric cookers in all the houses in place of gas cookers would prove very expensive, particularly in view of the call for economy in local authority spending.

American Atomic Power Plant

A contract has been signed by the United States Atomic Energy Commission with the Yankee Atomic Electric Co. (representing twelve utility companies) for the construction of a 134 MW atomic power plant at a cost of $34.5 million. According to the *Electrical World* (New York) the company will bear the whole cost of the plant, but the A.E.C. will underwrite the first $5 million of the cost of research and development and will waive its normal charge for the use of special nuclear material for the reactor for a specified period.

The reactor will be of a pressurised "light" water-cooled and moderated design and the fuel element will be of uranium oxide clad in stainless steel, instead of zirconium or aluminium. The plant is expected to go into operation in 1960. The development and design work is being undertaken by the Westinghouse Electric Corporation.

Radio Links for N.Z. Power Board

A contract to supply single-channel v.h.f. radio links to register consumer demand and control load shedding has been placed with Automatic Telephone & Electric Co. (N.Z.), Ltd. One of the first of its kind to be installed anywhere in the Commonwealth, the system has been designed for the South Canterbury Electric Power Board, an authority responsible for distributing power over an area of some 3,600 square miles.

The Board's headquarters is at Timaru and it takes its supplies from three points on the 11 kV State grid, at Temuka, Grants Hill, and Studholme. The radio links will replace conventional open-wire lines between these substations and the main Timaru control centre. Consumer demand will be metered at the substations, transmitted over the radio links, and then summated at headquarters for the automatic control of load shedding.

A supervisory and remote control system manufactured by A. T. & E., will be used to govern control equipment at the Grants Hill substation from headquarters. The two other substations will initially be fitted with metering equipment only, but provision has been made to extend the supervisory system to them if necessary in the future.

"Metropolitan" Improvements

On Monday last London Transport announced a £3½ million reconstruction and electrification scheme for the Metropolitan line.

The present double-track section from Harrow-on-the-Hill to south of Rickmansworth is to be duplicated to provide four tracks over seven miles: the line beyond Rickmansworth to Amersham and Chesham, now steam operated, is to be electrified over 10 miles. The works will give better running, higher speeds and more trains.

The scheme also provides for the present "Harrow only" trains from Baker Street to be projected as far as Amersham at peak times, giving travellers at most stations between an extra four trains an hour. The Chesham branch is included in the electrification and will have shuttles to connect with Amersham trains, as well as certain through trains in the peak hours.

The new pair of tracks beyond Harrow will involve the widening or rebuilding of 17 bridges between Harrow and Amersham, the rebuilding of Pinner, Northwood and Moor Park stations and extra platforms at Amersham and Chesham. The engineering work will begin in eighteen months and will take four years to complete.

Finnish Power Projects

THE World Bank has just granted a loan equivalent to $15 million for the expansion and distribution of electric power in Finland. More than half the loan will be in European currencies. It will help to finance three hydro-electric and two thermal power plants, with a combined generating capacity of 344,000 kW, and 235 miles of transmission lines. All the plants will become part of the integrated power system which supplies most of Finland's power to the main consuming centres.

The loan was made to the Mortgage Bank of Finland Oy, a new institution owned almost entirely by the Bank of Finland. The Mortgage Bank will relend the proceeds to the enterprises carrying out the projects as follows:—$6.2 million to Kemijoki Oy, a publicly owned power company; $3.8 million to Imatran Voima Oy, a publicly owned power company; $2.6 million to the City of Helsinki; $1.2 million to Kaukas Ab, a privately owned wood products company; and $1.2 million to Pargas Kalkbergs Ab, a privately owned cement company.

Most of the power produced in Finland is used by industry, particularly the wood products industry, in which power costs are a sizeable component of production costs. Demand for power has been increasing at the rate of 10 per cent per annum in recent years and can be expected to continue at this rate for the next few years. The expansion now being undertaken should meet the increase in demand expected by 1960.

The two power companies, Kemijoki and Imatran Voima, have in hand plans for the exploitation of water power resources in Northern Finland and the transmission of the power to the more populous and industrialised south. The $6.2 million allocation from the loan will assist Kemijoki in financing two new hydro-electric power plants on the Kemi River in Lapland, with a combined capacity of 220,000 kW. Both will be completed in 1960. Imatran Voima will use its allocation of $3.8 million to complete the construction of a transmission line from the Kemijoki plants to Southern Finland.

The third hydro-electric plant to be built with the help of this loan will be undertaken by Kaukas Ab. which will construct a 22,000 kW plant on the Pielis River at Kaltimo, in Eastern Finland, and will sell the power produced to Imatran Voima for distribution over the national grid.

The city of Helsinki and Pargas Kalkbergs are both constructing thermal power plants. Additional thermal capacity is needed for the national grid to assure a supply of firm power in dry years and to supplement hydro-electric power in periods of peak demand. Both the plants will be built in areas of heavy industrial demand and adjacent to existing auxiliary facilities. The Helsinki plant will have a generating capacity of 75,000 kW and will come into operation by November, 1959. Pargas Kalkbergs is building its 27,000 kW plant on the island of Pargas, near Turku, in south-west Finland. It will be completed in the second half of 1958.

The total cost of the six projects is estimated at the equivalent of about $103 million. The Bank's loan of $15 million will meet most of the foreign exchange requirements; it will pay for the importation of turbines, generators, switchgear, transformers and other materials.

Financial Section

STOCKS and SHARES

THE rather sorry appearance of Stock Exchange markets at the beginning of this July is in sharp contrast with conditions ruling at the same time last year, when the indices of industrial share prices were breaking almost daily the altitude records in their enthusiastic advance towards an all-time peak. This was reached shortly before the end of the month, when the boom became abruptly deflated by Mr. Butler's decision that the time had come to tighten up the credit squeeze. By the autumn the whole of the year's previous rise had been lost. There were subsequent rallies, but the declines of the past month or so have left prices with no net improvement since that time.

Dull Markets

Markets retreated before a combination of news items which included the B.M.C. labour situation, the decline in the latest industrial production index, the Australian import cuts and a drop in the exchange value of the pound. The last factor kept the gilt-edged market subdued. Among electrical equipment shares the key was set by falls of half-a-crown each, by the beginning of this week, in A.E.I. and English Electrics. Westinghouse and Tube Investments had lost the same amount, and declines of 1s or so were fairly widespread. A further fall of 1s 9d in Joseph Lucas was representative of the trend in shares associated with the motor industry. British Aluminiums, which are said to have acquired a good transatlantic following, again defied the general trend. New shares offered to shareholders of Power Securities Corporation at 28s were dealt in at a premium of around 9s. Johnson & Phillips' new 5¾ per cent loan stock, which became fully paid yesterday (Thursday), held to the issue price of 97.

Present Yields

The decline in industrial share prices over the past twelve months, taken in conjunction with some moderate dividend increases, has at least produced conditions in which new capital can be invested to give a living return on the money without a large element of risk. Whereas in mid-1955 the buyer was giving hostages to fortune in the shape of yields no higher than 3 per cent, or thereabouts, on many of the most popular industrials, he can now see about 4½ per cent on his money from shares in that class, and 5½ per cent or more from many reliable and promising issues. Where there are outstandingly conservative dividends, or particularly good prospects, yields are still well below the level of the gilt-edged market, cases in point among electrical equipment shares being Parsons, Reyrolle, Pye, Plessey, Thorn Electrical, A.E.I., English Electric and Babcock & Wilcox.

Five Per Cent Upwards

A glance down the accompanying tables shows that a good number of electrical shares of high standing now

Price Changes in

Company or Board	Nom. Value	Middle Price 2nd July	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	74½	—1	3	3	4 0 6	80½	74½
Brit. Elec. 1974/77	100	74½			3	4 0 6	79⅛	73⅜
Brit. Elec. 1976/79	100	77½	—1	3½	3½	4 10 3	84	78½
Brit. Elec. 1974/79	100	88½	—1	4½	4½	4 16 0	95	88
Overseas Electric Supply								
Calcutta Elec.	£1	19/6		6†	6†	6 3 0	20/9	19/-
East African Power	£1	19/-		7	7	7 7 3	21/3	19/6
Nigerian Elec.	£1	19/-		10	10	10 10 6	21/-	17/-
Palestine Elec. "A"	£1	21/-		Nil	Nil	Nil	21/-	21/-
Perak Hydro-Elec.	£1	15/6		10	10	—	17/6	14/9
Equipment and Manufacturing								
Aberdare Cables	5/-	11/-	—3d	17½	17½	7 19 0	13/6	10/6
Aerialite	1/-	5/-		88½	45*	9 0 0	6/9	5/-
Allen, W. H.	£1	37/6		20	10*	5 6 8	39/-	33/6
Aron Elec. Ord.	£1	55/9		15	15	5 7 6	56/-	53/6
Assd. Automation	10/-	17/-		10	5	2 18 9	—	17/-
Assoc. Elec. Ord.	£1	66/3	—2/6	14	15	4 10 6	85/6	57/9
Automatic Tel. & El.	£1	56/3		15	15	5 6 9	72/6	56/3
Babcock & Wilcox	£1	73/6	—2/-	15	15	4 1 9	85/6	64/-
Baldwin, H.	2/-	4/9		20	20	8 8 6	5/-	3/9
Bakelite	10/-	27/6	—1/-	16	16	5 16 6	34/-	26/9
Berry's Electric	5/-	6/6		—	10‡	7 13 9	6/6	5/9
British Aluminium	£1	61/3	+2/-	12	12	3 18 6	61/3	40/6
B.I. Callender's	£1	50/-		10	12½	5 0 0	54/3	45/-
B.I. Callender's 6% Pref.	£1	20/6		6	6	5 17 0	22/6	20/3
British Thermostat	5/-	26/3		20	25	4 15 3	31/9	24/6
British Vac. Cleaner	5/-	6/-	—3d	30	15*	12 10 0	8/9	6/-
Brook Motors	10/-	36/3		20	25	6 18 0	44/-	36/3
Brush Ord.	5/-	5/9	—6d	10	10	8 14 0	7/9	5/9
Bulgin, A. F.	1/-	4/9		45	50	—	5/3	4/3
Burco Daan	5/-	8/6	—3d	—	22½	13 4 9	13/3	8/6
Chloride El. Storage "A"	£1	63/3	—	17½	17½	5 10 9	73/6	60/9
Clarke Chapman	£1	107/6		20	22½	4 3 9	112/6	89/6
Cole, E. K.	5/-	16/-		17½	17½	5 9 6	22/3	15/6
Cossor, A. C.	5/-	7/-		10	15	10 14 3	10/3	6/9
Crabtree	10/-	28/-		20	20	7 2 9	29/3	27/-
Crompton Parkinson Ord.	5/-	13/9		20	16*	5 16 3	15/-	12/3
De La Rue	5/-	18/-		30	30	8 6 9	20/3	15/-
Decca	4/-	27/-		56¼	43¾*	6 9 9	44/9	24/9
Desoutter	5/-	27/9		25	30	5 8 0	32/9	25/9
Dewhurst	2/-	7/3		24	30	—	7/6	5/3
Dictograph Tel.	2/-	5/9		20	20	6 19 3	6/9	5/9
Dubilier Condenser	1/-	3/9		25	25*	6 13 3	4/6	3/6
E.M.I.	10/-	26/6	—6d	10	15	5 13 3	37/-	26/3
Electrical Components	5/-	12/6		20	25	10 0 0	16/-	12/6
Elec. Construction	£1	26/3	—1/3	8½	8½	6 9 6	29/9	25/-
Enfield Cable Ord.	£1	14/6	—6d	Nil	Nil	Nil	19/3	14/-
English Electric	£1	51/3	—2/6	12½	12½	4 17 6	66/3	47/3
English Electric 3¾% Pref.	£1	13/-	—6d	3¾	3¾	5 15 6	14/6	12/6
Ericsson Tel.	5/-	35/6	+6d	20†	20†	2 16 3†	42/9	33/6
Ever Ready	5/-	27/-	—3d	35	35	6 9 9	32/9	24/-
Falk Stadelmann	£1	36/9	—3d	15	17½	9 10 6	45/9	36/9
G.E.C Ord.	£1	53/9	—1/3	12½	14	5 4 3	65/6	50/-
G.E.C. 6½% Pref.	£1	22/6	—9d	6½	6½	5 15 6	23/9	21/3
General Cables	5/-	11/3	—6d	30	30	13 6 9	13/9	11/3
Greenwood & Batley	£1	47/6		17½	17½	7 7 3	47/6	45/-
Hackbridge Cable	5/-	22/3		20	25	5 12 3	24/6	18/9
Hackbridge & Hewittic	5/-	18/9		30	23*	6 2 6	22/-	17/3
Heatrae	2/-	4/3		15	15	7 1 3	5/1	4/3
Henley's	10/-	16/3	—1/-	10½	11½	7 1 6	19/9	14/-
Holophane	5/-	18/9		25	30	8 0 0	19/-	17/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
*After scrip issue. †Free of income tax. ‡Dividend forecast.

offer the investor a return of between 5 and 5½ per cent on the basis of the dividends last paid. They include, for instance, the shares of B.I.C.C., G.E.C., Ward & Goldstone, Richardsons Westgarth, E. K. Cole, Aron Meter and Lancashire Dynamo. Yields of between 5½ and 6 per cent are shown by, among others, Crompton Parkinson, E.M.I., Telegraph Condenser and Chloride Electrical. The range between 6 and 7 per cent covers Allen West, Decca, Ever Ready, Henley's, Electric Construction, Telephone Manufacturing and Walsall Conduits. Higher yields than that are fairly plentiful. Those running into double figures occur as a rule in such fields as electrical appliances, domestic equipment and others troubled particularly by the credit restrictions.

Electrical Investments

Company or Board	Nom. Value	Middle Price 2nd July	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
Equipment and Manufacturing—continued								
Hoover	5/-	26/-	—2d	70	50	9 12 3	39/3	23/-
I.C.I.	£1	42/9	—2/3	10	10	4 13 6	49/9	41/3
Intl. Combustion	5/-	19/6	—6d	25	20*	5 2 6	25/-	15/3
Johnson & Phillips	£1	40/9	—6d	15	15	7 7 3	46/6	37/6
Lancashire Dynamo	£1	42/6		15	11*	5 3 6	49/9	40/9
Laurence, Scott	5/-	15/6		12½	15	4 16 9	16/9	13/3
Lister, R. A.	£1	31/3		9.3	10	6 8 0	35/3	27/6
London Elec. Wire	£1	50/9	—6d	12½	12½	4 18 6	52/9	46/5
Lucas, J.	£1	29/6	—1/9	7½	7½	5 1 9	40/3	29/6
Marryat & Scott	2/-	11/-		25	30	5 9 0	11/-	9/6
Mather & Platt	£1	52/6		13.4*	15	5 14 3	65/3	51/6
Metal Industries	£1	18/6	—1/-	9	9	—	27/-	16/3
Midland Elec. Mfg.	£1	46/3		10	12½	5 8 0	48/6	43/6
Morphy-Richards	4/-	20/-		35	50	10 0 0	27/3	20/-
Murex	£1	68/3		15	20	5 17 3	70/3	60/-
Newman Ind.	2/-	2/6		10	10	8 0 0	2/9	2/1
Oldham & Son	1/-	2/3	—3d	17½	20	—	3/-	2/3
Parnall (Yate)	5/-	6/-	—6d	14	12	10 0 0	9/6	5/6
Parsons, C. A.	£1	85/-		10	10	2 7 0	85/-	61/6
Plessey	10/-	69/-	+1/6	27½	30‡	4 7 0	87/6	56/-
Pye "A" Deferred	5/-	17/6	+1/3	20	12½*	3 11 6	21/3	14/-
Revo	10/-	14/6	+1/-	9	9	6 4 3	14/6	8/3
Reyrolle	£1	105/-		15	16¼	3 2 0	110/-	81/-
Rheostatic	4/-	9/-		18½	12‡	5 6 9	—	8/3
Richardsons Westgarth	5/-	16/-		16¾	16¾	5 4 3	17/-	13/9
Scottish Cables	4/-	16/3		27½	27½	6 15 3	17/9	15/9
Smith (England), S.	4/-	11/6		17½	17½	6 1 9	14/3	11/-
Southern Areas	£1	17/6	—2/6	10	7½	8 11 6	28/9	17/6
Strand Elec.	5/-	7/9		17½	15*	9 13 6	8/6	7/3
Sturtevant	5/-	22/9	—3d	14.4†	15†	3 6 0†	31/3	22/9
Sun Elec.	£1	35/-		15	20	11 8 9	37/6	35/-
Switchgear & Cowans	5/-	13/9	+3d	20	25	9 1 9	17/-	13/6
Taylor Tunnicliff	5/-	12/3		15	15	6 2 6	14/-	11/3
T.C.C.	10/-	43/3		25	25	5 15 6	45/-	40/6
T.C. & M.	£1	28/-		8½	8½	6 1 6	34/-	26/-
Telephone Mfg.	5/-	7/6		10	10*	6 13 3	8/6	6/3
Thorn Elec.	5/-	17/6	—6d	20	15*	4 5 9	22/6	16/-
Thornycroft	£1	43/9		15	15*	6 17 3	49/9	41/3
Tube Investments	£1	56/3	—2/6	22½	14*‡	4 19 6	70/6	54/9
Vactric	5/-	12/6	—9d	15	17½*	7 0 0	15/-	11/6
Veritys	5/-	8/3		12½	12½	7 11 6	10/-	6/9
Walsall Conduits	4/-	13/3		70	20*	6 0 9	13/6	10/9
Ward & Goldstone	5/-	35/-		30	35	5 0 0	38/3	29/-
Watford	2/-	6/6		25	25	7 13 9	7/6	6/6
Westinghouse Brake	£1	73/9	—2/6	18	18	4 17 9	100/-	71/6
West, Allen	5/-	12/6	—3d	15	15	6 0 0	14/6	11/6
Wolf Electric	5/-	17/6	—1/-	20	20	5 14 3	26/3	17/6
Trusts, Transport and Communications								
Anglo-Am. Tel.:								
A. Ord	100	74		6	6	8 2 3	80	66
Ord.	100	47½		3¾	3¾	7 18 0	54	45
Anglo-Portuguese	£1	23/-		8	8	6 19 3	23/6	20/3
Brit. Elec. Traction:								
Def. Ord. "A"	5/-	17/-	—1/-	22½	22½	6 12 3	20/-	15/6
Cable & Wireless:								
Ord.	5/-	10/6	—3d	10	10	4 15 3	11/3	9/6
4% Loan	100	90½	—½	4	4	4 8 6	92½	88
Calcutta Trams	£1	25/-		6†	7½†	6 0 0†	26/3	23/-
Cape Elec. Trams	£1	18/3		5½	7½	8 4 6	20/3	18/-
Marconi Marine	£1	31/6		10	10	6 7 0	34/-	31/-
Oriental Tel. Ord.	1/-	67/6		16	—	—	90/-	71/3
Telephone Rentals	5/-	10/9		12½	12½	5 16 3	11/9	9/9

Hackbridge and Hewittic

A final dividend of 17 per cent from Hackbridge & Hewittic makes a total of 23 per cent for the year ended in March. It applies to ordinary capital increased to £750,000 as a result of last year's two-for-five scrip issue and an offer of new shares for cash. Allowing for the former, the payment for 1955-56 represents an improvement of about 1½ per cent on the previous distribution. With net profits moderately higher at £218,000, the dividend has twofold cover by earnings. These results fell in with market anticipations, and there was little further change in the price of the 5s shares on which, at 18s 9d, the yield goes up to 6.1 per cent.

Bowthorpe Holdings

Annual results published recently by Bowthorpe Holdings were the first to appear since part of the £300,000 ordinary capital was offered for sale, at 8s 9d per 2s share, a year ago. They stand now at about 10s 6d and provide a yield of 6⅔ per cent on the basis of the 35 per cent dividend paid for last year. This was the rate forecast in the prospectus at the time of the issue, when profits for 1955 were estimated at not less than those of the previous twelve months. In the event the surplus after tax came out substantially higher at £281,000, which is more than four times the net amount distributed in dividends. Viewing prospects, the chairman's statement mentioned that business in the first six months of this year had been affected to some extent by economic conditions, but more recently there had been signs of improvement.

James Scott

Another company of which the share capital was first introduced to the Stock Exchange last summer, James Scott & Co. (Electrical Engineers), has lately published its annual results. In this case also the profits figure, at £182,000 (before tax), represents a material increase and compares favourably with the prospectus estimate. The well-covered 18 per cent dividend is a fraction higher than the rate forecast. The present quotation of about 11s 6d for the 5s shares is level with the price at which they were initially placed in the market, and produces a yield of 7.8 per cent. Published particulars of the company showed a division of the business between various forms of electrical engineering and activities connected with radio and electrical appliances. In the former category mention was made of a substantial contract with the Atomic Energy Authority for installations at Dounreay.

REPORTS AND DIVIDENDS

Richardsons, Westgarth & Co., Ltd.—In his review of the company's activities during the past year, Mr. O. J. Philipson (chairman), refers to the progress made by the North Eastern Marine Engineering Co., Ltd., and George Clark & North Eastern Marine (Sunderland), Ltd. With regard to Richardsons, Westgarth (Hartlepool), Ltd., three turbo-alternator sets of 142 MW total capacity were commissioned for the Central Electricity Authority during the year. One of these sets included the company's first hydrogen-cooled alternator. A record rate of commissioning was achieved by the Land Boiler Department. Eight large boilers were put into service, including one of 300,000 lb/hr evaporating capacity for the C.E.A. A variety of other land installations were also completed. Richardsons, Westgarth Atomic, Ltd., was recently formed under the chairmanship of Mr. H. Fothergill, for the purpose of undertaking studies and developments in the atomic field, whether for use at sea or ashore. During the year, orders had been secured at a satisfactory rate and included further important work for the Electricity Authority and for industrial customers in the form of turbo-alternators, boilers, compressors, exhausters, etc.

John Thompson, Ltd., report a group trading profit of £2,113,866 for 1955, as compared with £2,049,591 for 1954. After deducting £991,262 (£954,464) for tax and meeting other charges the net profit was £752,667 (£777,586). The ordinary dividend of 25 per cent compares with last year's distribution equivalent to 21¼ per cent, allowing for the three-for-five capitalisation issue in February, 1955.

Mr. E. W. Thompson, the chairman, says that owing to continually rising costs which the company has endeavoured to absorb rather than pass on, profit margins have been reduced so that the increased output is not reflected to the extent it should have been in increased profits. The year was one of development and further expansion and capital expenditure was increased by over £200,000 to £520,918, exclusive of £226,658 in respect of the South African subsidiary. In the first three months of 1956 the output of the home group companies has shown a satisfactory increase, while orders on hand for the manufacturing companies show a considerable advance. Meeting, 18th July.

E. K. Cole, Ltd.—Group trading profits for the year ended 31st March last amounted to £1,021,874 (against £933,030 for 1954-55). Depreciation took £106,568 (£93,505), employees' pension and life assurance scheme £40,611 (£30,923), employees' special bonus distribution £78,882 (£60,401) and tax £445,000 (£402,750). As already reported, the net profits were £328,733 (£304,779). Reserve for employees' supplementary pensions receives £10,000 (same) and general reserve £250,000 (same). Preference and preferred ordinary dividends require £18,513 (£17,847) and the ordinary dividend is maintained at 17½ per cent, leaving £257,439 (£291,559) to be carried forward. Meeting, 19th July.

Richard Johnson & Nephew, Ltd.—The annual meeting was held on 22nd June, Mr. M. A. T. Johnson presiding. In referring to the increased output of ferrous wire, Mr. Johnson said that they were able to get more steel and the output went up by 11 per cent. Direct exports were down due to the dock strike, the long period of shipping congestion causing many of their customers to buy heavily elsewhere. Mr. Johnson spoke of the difficulties created by the fluctuations in the price of copper and the two-price system resulting from the decision of the Rhodesian Selection Trust to abandon the day-to-day London Metal Exchange price and to sell on a fixed basis.

The Electric Construction Co., Ltd., reports a net profit for the year to 31st March last of £104,061, as compared with £123,203 for the previous year. Taxation absorbed £96,151. General reserve receives £50,000 and the dividend for the year is unchanged at 8½ per cent. The balance carried forward is £72,568 (against £67,723 brought in).

Ward & Goldstone, Ltd., report that group trading profits rose from £741,823 in 1954-55 to £891,324 in the year ended 31st March last. After tax, net profits for 1955-56 amounted to £343,475 (against £327,103). The ordinary dividend is being increased from 30 to 35 per cent. Meeting, 25th July.

The chairman (Mr. S. Goldstone), in his statement accompanying the report and accounts, says that sales and production exceeded all previous records and, by virtue of technological progress, productivity has achieved a noteworthy advance. The past year has been one of keen competition with consistently narrowing profit margins and the directors can see no prospect of any alleviation of the situation. On the contrary, there are symptoms of severe intensification and the chairman says he cannot forecast that profits will be maintained at the levels of the last few years.

Broadcast Relay Service, Ltd., reports group trading profits of £3,196,812 for the year to 31st March last, as compared with £2,927,898 for the preceding year, and after meeting all charges, including £660,875 for taxation, the net profit is £771,107 (against £673,935). It is proposed to pay a final ordinary dividend of 7½ per cent, tax free, making 12½ per cent, tax free, for the year on capital doubled by a scrip issue (against the equivalent of 11¼ per cent). The balance carried forward is £490,835 (against £456,921 brought in).

Hackbridge & Hewittic Electric Co., Ltd.—The final dividend of 17 per cent makes a total of 23 per cent for 1955-56 on capital increased by "rights" and scrip issues to £750,000. (For 1954-55, 30 per cent was paid on £500,000 capital.) The consolidated trading profit amounted to £534,079 (against £524,931). Tax, after crediting £15,000 over-provided, required £244,428 (£248,934) and the net profit was £217,529 (£213,284). Reserve receives £100,000 (same) and £68,481 is carried forward (against £74,325 less £14,567 capitalised). Meeting, 27th July.

James Scott & Co. (Electrical Engineers), Ltd., which was converted into a public company in July last year, is paying a final dividend of 13 per cent, making 18 per cent for the year to 31st January, last, compared with a forecast of 17½ per cent. Profits amounted to £198,987 (against £162,008) before charging £91,838 (£71,918) tax and £17,140 (£13,686) directors' remuneration. General reserve receives £20,000. Meeting, 31st July.

Venner, Ltd., announce a net profit for 1955, subject to audit, of £46,202 (against £50,069), after providing £57,165 (£47,752) for taxation. General reserve receives £25,000 (£30,000). The dividend for the year is maintained at 15 per cent. Meeting, 17th August.

Keith Blackman, Ltd., report a net profit for the year ended 31st March of £125,386 (£112,347). The dividend is unchanged at 15 per cent. Meeting, 19th July.

International Combustion Africa, Ltd., has announced an interim dividend of 15 per cent (unchanged).

Bankruptcies

A. J. Sweeny, 86, Albert Road, South Norwood, London, S.E.25, electrical contractor.—Receiving order made 16th June on debtor's own petition.

C. R. Boydon, Ivy House, Thorpe Mandeville, near Banbury, Oxon, electrical engineer.—Order made 14th May suspending discharge for six months.

G. H. Evans, Steps House, Fletching Street, Mayfield, Sussex, radio, electrical and television engineer, carrying on business at High Street, Mayfield, in the name of G. H. Evans & Co.—Trustee, Mr. J. S. Bradley-Hole, 7, Old Steine, Brighton, appointed 19th June.

F. H. Pountney, trading as Bordesley Electric Co., 164, High Street, Bordesley, Birmingham, electrical engineer.—Last day for receiving proofs for dividend 7th July. Trustee, Mr. R. K. Clark, Somerset House, 37, Temple Street, Birmingham, 2.

D. L. Stoneham, 3, Crombey Street, Swindon, Wilts, electrical contractor, lately carrying on business at that address.—Last day for receiving proofs for dividend 10th July. Trustee, Mr. G. W. Sisman, 26, Baldwin Street, Bristol.

Engineering in Europe

ABSTRACTS FROM FOREIGN TECHNICAL JOURNALS

THE noise problem seems to assume ever greater proportions and to increase almost daily, with so far only faint hopes that it can be reduced to a bearable level. However, this applies above all to outdoor noises whereas, particularly in the industrial sphere, great and not altogether unsuccessful efforts have been and are being made to master it. They must obviously be based on careful investigations and measurements of sources of noise, propagation, reverberation, etc., in every individual case, before the methods of abatement can be considered. In the measurement of acoustic energy or sound pressure produced the concept of acoustic impedances is introduced with advantage; in the consideration of propagation and reverberation phenomena the concept of the "equivalent area of absorption" is useful.

The theoretical fundamentals and practical measuring methods in this field are now fairly well established and generally accepted, and have been incorporated in most national regulations (where they already exist). More controversial is the way in which the results of absolute noise measurements should be evaluated for determining the nature of the physiological effects due to them, as is proved by the existence of different sets of isosonic curves (e.g. Fletcher and Munson's as contrasting with Churcher and King's) and different sonic scales. The paper compares, in all the required details, the American methods and practice with improved apparatus and methods developed and used by the Electricité de France and incorporating a new element, viz. a thermal integrator, for measuring acoustic power. The special application to electric motors is described.—"Noise Measurement and Analysis; Application to Electrical Machines," P. Baron, *Bull. Soc. Franc. Elect.*, 7th Ser., Vol. 6, No. 62, pp. 143-163, February, 1956, in French.

Paper Capacitor Impregnation

Polychloro-naphthalenes are very valuable impregnating compounds, particularly owing to their excellent performance at high temperatures. However, since not only is their chemical constitution very complex and variable with the degree of chlorination, but the dielectric and temperature characteristics may vary a good deal with the constitution, at least temporarily, a homogenisation and stabilisation of these important characteristics is very necessary.

This requirement can partly be obtained by maturing the impregnated capacitors, but an even more efficient method, discovered by the author, consists in applying a relatively weak electric field to the impregnated capacitors during the crystallisation period of the impregnant. This method not only solves a special practical problem, but also sheds light on important general relationships between the dielectric characteristics and the crystalline state of polar organic substances.—"Paper Capacitors with Polychloro-naphthalene Impregnation," J. Coquillion, *R.G.E.*, Vol. 65, No. 3, pp. 185-193, March, 1956, in French.

Transformer Outages

It is well known that in 110 kV systems with solidly earthed neutral many transformers work with insulated neutrals. Since atmospheric flashovers on insulated neutrals are very infrequent, the protection of such transformers is often somewhat neglected. Although the Soviet regulations recommend the erection of valve-type surge diverters on transformer neutrals not insulated for the full line voltage, this does not extend to transformers of foreign make with fully insulated neutral and co-ordinating rod-gaps on all the bushings.

An interesting case of the outage of a 20 MVA transformer (Metrovick) 110/35/6 kV with insulated neutral erected in a substation comparatively far from two points where lightning struck the line, could be reconstructed in all details. The rod gaps had broken down and the three circuit-breakers of the transformer (110, 35 and 6 kV) were tripped by the zonal protection. The transit line struck by lightning (on which the wood poles and cross-arms of six supports of the portal type had been splintered), being one of two parallel lines supplied by the station, was cut out by the protection of its two dead-end substations, whereas at the same time the other (parallel) line remained in service.

In two phases of the cut-out transformer the surge diverters had also responded and the rod-gap in the transformer neutral had broken down. From the volt-second characteristic of this rod-gap it was easy to find that the surge waves must have impinged on all three phases, otherwise the required impulse voltage of about 540 kV would not have been reached. At the points of the strokes, where the supports had been splintered, the voltage must have had peaks of at least 4,900 kV. Control calculations show that the line bushings of the transformer must have been stressed by 400 kV, the neutral bushing by 700 kV.—"Analysis of a Transformer Outage Due to Lightning Surges," F. A. Likhachev, *Elekt. Stantsii*, No. 3, pp. 44-47, 1956, in Russian.

Generator Surges

The present practice in restoring the parallel operation of individual power stations with a heavy loading, or of parts of interconnected power systems after sectionalisation for any reason, is to use automatic reclosing with control and recovery of synchronism, or with self-synchronisation. Where the powers transmitted are considerable, the first method may not always work, because the reclosing gear with recovery of synchronism may fail to achieve its purpose. Reclosing with self-synchronisation, on the other hand, can only be applied to feeders connecting a power station to a system, and not to tie lines interconnecting individual parts of a system.

Comprehensive investigations on the restoration of normal operation after disconnection of interconnectors or tie lines by reclosing without synchronisation were carried out by the Central Electrical Research Laboratory of the U.S.S.R. It was found that if the reactances in the affected line were large enough, reclosing without resynchronisation involved no dangers for either generators or system. Under this condition, reclosing without control of synchronism may be applied to individual tie lines or interconnectors. Formulæ are presented for checking the electromagnetic torques set up in such cases. The maximum torque on reclosing without control of synchronism is set up for a hydro-generator thrown on at a power angle $\delta_0=135$ deg and for a turbo-generator thrown on at $\delta_0=120$ deg. Considerations of the mechanical strength

of the generators limit the permissibility of reclosing without control of synchronism to cases in which the amplitude factor of the theoretical surge currents does not exceed 3 for hydro-generators, and remains below 5 for turbo-generators.—" Surge Currents and Torques on Asynchronous Throwing-on of Generators," A. A. Khachaturov, *Elektrichestvo*, No. 2, pp. 21-26, 1956, in Russian.

Insulator Fittings

Comprehensive flashover tests of insulator strings in the D.C. Research Institute have shown that the so-called " Torok-curve " conveys a wrong idea of the possibility of preventing cascade-flashovers of insulator strings by protective fittings. Also, the hitherto undoubted fact that the flashover voltage of the insulator strings is raised by the effect of rendering the voltage distribution along the string more uniform, i.e. relieving the stress on the most highly stressed elements of the string, must be qualified, since the tests have shown that even at the commercial frequency and on dry strings considerable ionising currents precede a flashover, so that at actual flashover inception the voltage is, *ipso facto*, practically uniform. This means that a protective fitting does not improve the conditions in this respect at the critical instant. Moreover, a badly designed fitting may even reduce the flashover voltage.

The conclusions drawn may be summarised as follows. Below 220 kV no protective fittings are required at all, nor on the straining strings of 220 kV lines. On 220 kV suspension strings protective fittings may reduce the corona phenomena on the insulators, but since the latter are not dangerous at this voltage the fittings may safely be dispensed with. Above 220 kV, and particularly at 400 kV, protective fittings must be used and have the advantage of appreciably reducing the number of string elements required (viz. from 24 to 20).—" The Protective Fittings of Insulator Strings of Overhead Lines," A. K. Gertsik, E. V. Kalinin, A. V. Korsuntsev and S. D. Merkhalev, *Elektrichestvo*, No. 3, pp. 69-72, 1956, in Russian.

H.V. Circuit-Breakers

A further contribution to the experimental investigations of inter-relations between recovery voltage and post-arc current and conductivity of the break, based on experimental work in the Brown-Boveri laboratories, confirms the general character of these inter-relations, viz. that post-arc current and conductivity depend not only on type of breaker and breaking current, but also on rate of rise of the recovery voltage and its frequency (thermal ionisation due to the recovery voltage).

According to all these variable factors, p.a. current and conductivity will also vary within wide limits even in the same breaker. Inversely, the recovery voltage may be influenced by the p.a. conductivity in the break, and in a particularly marked degree if the period of the natural frequency is of the same order of magnitude or smaller than the duration of the post-arc current. It is, however, possible to define a characteristic post-arc conductivity of the breaker, viz. a conductivity depending only on breaker characteristics and breaking current. This conductivity can be measured under certain artificial and standardised testing conditions.

The range of variation, or dispersion, of the values of magnitude and duration of the p.a. current is much wider in oil than in air-blast circuit-breakers and when the natural frequency is below 5 kc/s, a damping influence of the post-arc conductivity on the recovery voltage cannot be established with any certainty. The very short and low post-arc currents in air-blast breakers confirm the well-known short-circuit clearance abilities of these breakers and explain the high overvoltages across their break. The paper contains valuable information on the necessary conditions to be satisfied by synthetic testing circuits.—" Post-Arc Current and Conductivity in H.V. Circuit-Breakers," P. Baltensperger and P. Schmid, *A.S.E. Bull.*, Vol. 47, No. 8, pp. 333-340, 14th April, 1956, in French.

Phase Difference Protection

The operation of the h.f. channels of the differential-phase protection type DFZ-2 (cf. *Elektrichestvo* No. 6, 1955) is characterised by the use of the lowest possible operating frequencies (usually below 70 kc/s) and by the considerable influence of the signals reflected at the far end of the line. The receivers of the differential-phase protection must have a pass band width of 1,300-1,400 c/s, which means that the coupling between the h.f. circuits of the receiver must be above the critical value. This distorts the form of the envelope of the rectangular pulses on the output side, which assume an oscillatory character, or split up into primary and secondary pulses, the second still of an amplitude comparable with that of the emitted pulse. Methods are discussed to obviate this very troublesome phenomenon.

Even more serious is the effect of the pulses reflected at the line end, the amplitude of which depends on the matching of the impedances of the various elements of the h.f. channel and the line attenuation for the operating frequency. Again, the reflected amplitude may be comparable with that of the original signal. Considering the sensitivity of the receiver, a tuning-out of the reflected signal is not always possible. An analysis of possible and probable cases shows, however, that the phase relations between direct and reflected pulses are such that the latter cannot interfere with the correct operation of the h.f. protection, except in some cases when it renders the latter " hypersensitive." Their elimination is then possible by methods essentially amounting to careful impedance matching.—" Characteristics of the Operation of the H.F. Channels of the Differential-Phase Protection of Long Transmission Lines," G. V. Mikutskii, *Elektrichestvo*, No. 4, pp. 48-51, 1956, in Russian.

Reinforced Concrete Masts

The problem of the most reliable and economic types of supports for modern h.v. and e.h.v. power grids is still unsolved, despite the impressive amount of research work in this field carried out literally throughout the world. The tendency to replace steel towers or masts by ferro-concrete structures is fairly general and the combination of steel tubes with a concrete filling is one of the alternatives competing with spun-concrete poles and masts. The author surveys and compares the types developed by various Soviet power systems and the operational experience gained with them, and also contrasts the results with data made available from other countries (Switzerland, Germany).

For Soviet conditions spun-concrete masts are the preferable types for 35 kV and single-circuit 110 kV lines, especially if the required heights are 11-20 m and a conical section is chosen. For voltages of 110-220 and 400 kV steel tubes filled with spun concrete are recommended as the most up-to-date type, also achieving a saving of steel. It is stressed that the steel saving with pure ferro-concrete masts is not achievable unless the reinforcement is properly adjusted and tensioned beforehand. The spun-concrete types of masts are susceptible of improvement to render them more competitive with tubular concrete-filled types. The present qualities of prefabricated concrete structures and the technology of their production also come in for criticism.—" Reinforced Concrete Masts for 35-400 kV Overhead Lines," A. N. Alekseev, *Elekt. Stantsii*, Vol. 3, pp. 32-36, 1956, in Russian.

Electrical Manufacture in France

From a Paris Correspondent

IN the French electrical engineering industries there are 5,700 undertakings of which 41 per cent are companies, 24 per cent private firms and 35 per cent are run by craftsmen. Some forty enterprises are alone responsible for half of the total output and employ approximately half of the entire labour force engaged in this work. In terms of importance, one hundred leading undertakings represent two-thirds of the whole trade. From 136,000 employees in 1938, the labour force increased to 189,000 in 1949, and 226,000 in 1955 of whom 68,000 are classified as supervisory staff.

The production in 1955 of the electrical and electronic industries was treble that of 1938, and has risen by 70 per cent since 1949. From 7,700 million francs in 1938, sales figures rose to 219,000 million fr. in 1949, and 540,000 million fr. in 1955; the increase last year over 1954 was more than 50,000 million fr., or about 13 per cent (980-982 fr. = £1).

Expansion was uneven throughout the various sections of electrical engineering, a number of branches having suffered from delayed action in the placing of Government orders in previous years, or from certain Government measures such as price control or restricted aid to exports.

Since 1949, the average pay per working hour and the average monthly salary for a technician are calculated to have increased by 43.7 per cent and 53.2 respectively. On the whole, the living standards of the 226,000 people engaged in electrical engineering work have improved by some 50 per cent since 1949.

Advance in Production

The electrical engineering industry is one of those which experienced the greatest prosperity during 1954 and 1955. Whereas in 1953, the production index prepared by the Syndicat Général de la Construction Electrique showed only slight progress as compared with the previous year (103 as against 100), the same index reached 119 for 1954. Now it is estimated that an increase of 8 to 10 per cent was registered in 1955 : the production index established this time on the basis of 100 in 1949 indicated an increase from 163 to 177 between October, 1954, and October last year.

The evolution of the total figures for the labour force is not truly representative of this expansion: this force (including staff) has varied from 199,700 in 1952 to 198,300 in 1953, and 215,800 in 1954.

Owing to the development in productivity methods, the increase in turnover has been substantially higher : whereas it was 428,700 million francs in 1952 and 426,600 million francs in 1953, it rose to a total of 480,000 million francs in 1954 and, according to estimates, it may well have reached 550,000 million francs in 1955, that is about three times the pre-war figure, as expressed in terms of constant value.

Development in Various Branches

The above statistics reflect the general aspect of an industry with very many branches, but the evolution of these various branches may greatly differ and at times may even take opposed directions.

The accompanying table shows the trend of production in the various branches on the basis of the index established by the Syndicat de la Construction Electrique (1952=100).

Branch	1953	1954
Heavy electrical equipment	87	75
Light and medium electrical machines	88	106
Distribution equipment	102	99
Installation equipment	108	140
Electric batteries	95	103
Domestic electrical appliances	120	142
Meters and measuring apparatus	93	106
Electric lamps	109	129
Insulators and moulded articles	92	127
Electric wires and cables	93	106
Telegraph and telephone equipment	116	126
Radio and television receivers	115	188
Radio spare parts	113	151
Radio equipment for the trade	146	185
Electronic valves	117	122

From the annual report of the Commissariat Général au Plan (General Board of Planning) the electrical engineering industry can be divided into three main sections, according to the kind of users their products are intended for:—

The first section includes heavy plant and equipment branches which supply chiefly the main national undertakings in the home market. Owing to the tightening-up of credit and a somewhat slower progress of important works, output in these industries generally has either decreased very appreciably since 1952, as has happened with heavy electrical equipment, or remained static, as in the case of distribution apparatus and plant.

Those undertakings whose products are intended for industrial companies experienced a temporary reduction in business as a result of restrictions on capital expenditure, but they reached a higher level in 1954, and this expansion of activities continued generally in 1955, concurrently with general industrial recovery. Items in this class include medium and small electrical machines, batteries, meters and measuring apparatus, insulators and moulded articles, and electric wires and cables.

The third section, whose products are supplied solely for general consumers, experienced considerable expansion in 1954, and even more in 1955. This increase has been due to the rise of purchasing power, following general business prosperity and higher wages, and by the now widely adopted hire-purchase system. Sales of all kinds of domestic appliances in 1954 were up by 42 per cent as compared with 1952, and an increase of a similar order seems to have occurred in 1955.

With regard to sales of medical equipment, particularly of outfits for medical radiographers, figures have doubled in the past five years, concurrently with the development of techniques. The expansion of building construction has enabled lift manufacturers to treble their business since 1949.

The most spectacular advance in sales has been in the field of radio equipment, and particularly television, as is shown by the following output figures (quantities):—

	1952	1953	1954
Radio receivers	850,000	850,000	950,000
Television receivers	28,000	58,700	110,500

In 1955, the rate of increase was greater : the production index (on the basis of 1949=100) for " radio and tele-

vision receivers and sound apparatus" went up from 285 in October, 1954, to 375 in October, 1955. From information recently supplied at a meeting of the Académie du Disque Français, the total turnover of record, radio and television set, electrophone, valve and spare part manufacturers was stated to have reached 100,000 million fr. in 1955, an increase of 20 per cent over the previous year.

Again concurrently with the expansion of building activities, there has been an important increase in the production of electrical fittings and probably of electric lamps as well. In these fields, prospects remain very promising for the French market is far from being saturated.

All electrical engineering industries, particularly those producing industrial equipment, have rapidly increased their export business in the last few years. The present rate of exports is about 50,000 million fr., which represents a volume of about four times the pre-war figure.

Approximately half of the exports go to the French Union which last year absorbed about 25,000 million francs' worth of electrical equipment (15,000 million fr. for North Africa alone). Next to Algeria, Morocco is the second largest consumer; Morocco buys mostly domestic appliances and radio and television equipment. Tunisia imports telephone and industrial equipment; West Africa takes a good deal of electric motors and lighting equipment.

During 1954, the total sales by French industry of electrical equipment in the French Union territories increased by 11 per cent as regards domestic electrical equipment, by 31 per cent for radio apparatus and by 38 per cent for telephone and telegraph equipment.

In spite of stiffer competition, French firms managed to export to foreign markets nearly 25,000 million francs' worth of equipment in 1954, an increase of about 25 per cent over the previous year. Of this total 9 per cent went to the dollar areas, 4 per cent to the sterling area and the remainder to other countries.

The most spectacular increases have occurred in the case of Turkey, where sales rose from 530 million fr. in 1953 to 949 million fr. in 1954; the United States, where sales in 1954 (921 million fr.) were three times the figure for the preceding year; and Chile, where sales went up from 221 million to 757 million fr.

Among the most important projects with which French firms are concerned are the construction of the Laxapana hydro-electric station in Ceylon, the steam generating station at Soma, in Turkey, the stations at Funil and Figueira in Brazil, and another important station in Lebanon. It may be remembered that during the last few years French industry has built five power stations in Argentina (60,000 kW), nine in Brazil (118,000 kW), four in Spain (108,000 kW), six turbo-alternator groups in Holland, and five in Poland.

Lighting the Champs-Elysées

SOME stir has been caused in Paris recently by the inauguration of new lighting on the Avenue des Champs-Elysées. Since 1859 (the time of the Second Empire) this famous thoroughfare has been lighted by gas candelabra designed by the architect Hittorf and the city authorities were loth to let them go. It was therefore decided to retain them and reinforce them with a line of standards on each side. The effective height of the standards is 8½ metres (about 28ft) and there are 200 of them spaced at from 22 to 28 metres (73-93ft).

Each standard has two curved arms upon which are mounted hemispherical lanterns. In each lantern there are two lamps—one incandescent, the other fluorescent. On the footpath side the lamps are respectively 300 W and 125 W; those on the road side are 500 W and 250 W. The fluorescent bulb-shaped lamps were supplied by Claude Paz et Silva and the Cie. des Lampes Mazda and the incandescents by the Société Visseaux.

Lighting in the Avenue des Champs-Elysées and (right) one of the new standards next to an existing gas lamp-post

SOME MODERN APPLICATIONS OF

Barrier-Layer Photo-Cells

By T. THORNE-BAKER, F.Inst.P., A.M.I.E.E., F.C.S., F.R.P.S.

IT is 75 years since Elster and Geitel claimed to have detected the light of a candle half a mile distant by means of one of the early emission types of photo-cell, and half a century since selenium photo-cells came into practical use. To-day the barrier-layer type of selenium cell, due to its high light-sensitivity and direct generation of electric current, has entered into an astonishing variety of physical fields.

Selenium is a non-metallic element resembling tellurium and sulphur from a chemical standpoint, and occurs naturally in various allotropic forms. Its melting point is 217 deg C and its resistivity at zero deg C is 60,000 ohms. The resistivity can be reduced to as little as one two-hundredth part when selenium is strongly illuminated. The light sensitivity is obtained by annealing the element at a temperature near to its fusing point, and in the earlier types of cell powdered selenium was deposited upon a glass or steatite plate having two wire spirals wound round it close together but not touching; electrodes were attached to one end of each spiral. This type was often known as a selenium bridge. It was used by A. Korn in his first instruments for the telegraphy of photographs: and similar cells were used with considerable success by Toy and Rawling in the construction of the density reading meter introduced by the British Photographic Research Association.

The type of selenium cell with which we are concerned in this article is one which generates an electric current when illuminated by visible radiation, of sufficient strength to operate either a sensitive galvanometer or a micro-ammeter. As an example of output, a circular cell 45 mm in diameter, connected to a circuit resistance of 200 ohms, will give an output as high as 600 μA.

The process of preparing the selenium, the annealing and other technical details, have been the subject of continuous study for many years, notably by the Evans brothers, and the generous output of energy obtained has greatly widened the field of application. Requiring no external current, they are not affected by any mains fluctuation. Short circuiting has no ill effect, and reasonably used, the life of a cell is indefinite.

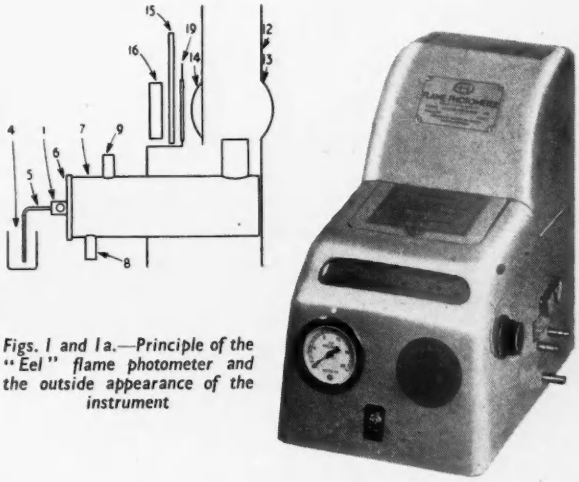
In the construction of a barrier-layer cell, pure molten selenium is applied to a thin steel plate and the plate is subjected to considerable pressure combined with heat treatment; in this way a smooth, even coating is obtained. Over this surface when cold is sputtered a transparent layer of metal to provide a conducting surface. A narrow ring or strip of low melting point metal is next sprayed on to the surface of the cell near the edge to form the negative contact, the back of the steel base plate forming the positive contact. The back of the "cell" and the metal ring on the surface are connected with the galvanometer or meter.

We can now describe some of the instruments in which the barrier-layer cells are employed. The determination of sodium and potassium in cement, of lithium in ores, and the percentage of potassium and calcium in soils—these are but a few of the extensive applications of the photo-cell. For this work a flame photometer has been designed by the Evans Electroselenium Co., which incidentally provides a very convenient and accurate means of determining the alkali contents of glass.

It is of course well known that if a metallic salt, such as sodium chloride, is introduced into a non-luminous flame, the latter burns with a colour characteristic of the metal. Analysis of the bright spectral lines in the flame as measured by a spectrometer is old established practice, and in recent years quantitative estimations have been made with considerable accuracy. But it is interesting to note that the mere brightness of the flame produced under controlled conditions makes possible with a photo-cell accurate quantitative measurements of extremely minute percentages of metallic salts.

The principle of the "Eel" flame photometer can be seen from the diagram in Fig. 1. The prepared liquid to be tested is placed in a beaker (4) and air is introduced to an all-metal atomiser (1) through a valve at a carefully controlled pressure. The stream of air atomises the liquid to a fine mist. The atomiser clips into a plug at one end of a spray chamber (7) in which any large droplets fall from the stream and flow to waste through a drain tube (8). Coal or other burning gas, the pressure of which is automatically stabilised, enters the spray chamber and the gas/air mixture burns in a flat flame, the hot gases of combustion passing up the chimney (12). A reflector (13) and lens (14) focus the light via a colour filter (15) on to the photo-cell (16). The current generated by the cell, depending on the brightness of the flame, is taken through a calibrated potentiometer to the galvanometer unit. It is hardly necessary to state that any such measurements are made against carefully prepared standard solutions of the metallic salts in question.

The sensitivity of the flame photometer is such that a full-scale deflection on the Tinsley galvanometer can be obtained with 5 parts per million of sodium or 10 parts per million of potassium metal. In connection with the determination of the alkali contents of glasses, the British Scientific Instrument Association states that alkali analyses can be carried out on glasses in about two hours, where gravimetric chemical analyses take at least one day. The saving of time by the use of the flame photometer appears



Figs. 1 and 1a.—Principle of the "Eel" flame photometer and the outside appearance of the instrument

to be confirmed in the case of soil and cement analyses and in the examination of biological specimens.

Density Measurement

When a photographic sensitive material is exposed to a standard light source for times varying geometrically (most easily done by means of a neutral grey step-wedge, the transmission of each step varying by x2 or $x\sqrt{2}$) the response to light on development can be measured by reading the densities in the exposed material after development and plotting them as a graph correlating density and log exposure. From such a characteristic curve the speed, latitude and general qualities of the material can be accurately determined, and the method is generally accepted and practised throughout the world.

In early measurements, the pioneers of sensitometry, Hürter and Driffield, used a very simple photometer of the Bunsen grease-spot type, comparing the light from two paraffin lamps, one of which was screened by the steps of the negative, using a logarithmic scale calculated on the inverse square law. To-day sensitometric measurements are made on precisely similar lines, but the densities are measured by means of photo-cells. The scheme in its simplest form is seen in Fig. 2. Light from a controlled source L is reflected upwards by a mirror M, and is passed as a narrow beam through the negative of the step-wedge, on to a photo-cell SE. The response of the cell is registered on a micro-ammeter G calibrated in densities.

The writer showed at a meeting of the Faraday Society that even with very low illuminations the response of a selenium cell was practically linear, and in an investigation of extremely slight "fog" in X-ray films it was found that densities of as low as 0.005 could be accurately determined by means of a barrier-layer cell. Several density measuring instruments using the cells have come into being in the last few years and are doing excellent work in photographic and other investigations. A popular form of densitometer is seen in Fig. 3.

An application of photo-cells to photo-engraving is proving of considerable use. The copy-board of the photo-engraver is usually illuminated by arc lamps, and fluctuations in the arc flame can cause quite an effect on the actinic value of the light and the consequent exposure. Plates, whether wet collodion, collodion emulsions or dry plates or films, are often of considerable size, and wastage

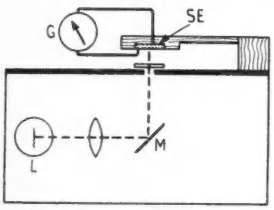


Fig. 2.—Density measurement

Fig. 3.—Universal densitometer

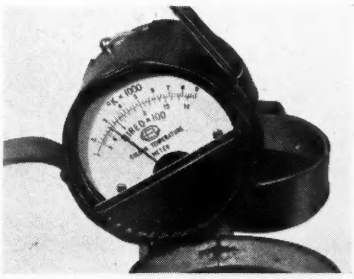
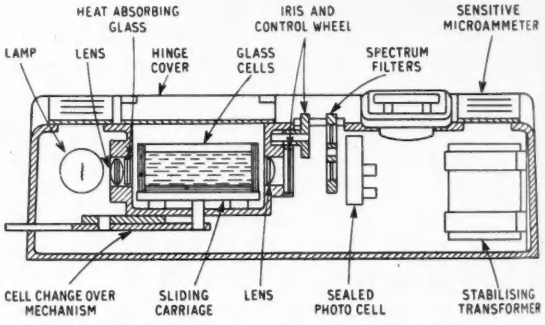


Fig. 4. — Typical colour temperature meter

Fig. 5. Hilger biochemical absorptiometer (right)

Fig. 6.—A long-cell absorptiometer (below)



of material can be serious, apart from operators' time. By means of a suitable electronic circuit it is possible to integrate the fluctuations in output with a photo-cell, and to show on an indicating instrument when a prejudged exposure has been reached. Fortunately the exposure x time effect in a photographic material is sufficiently consistent over a wide range of light intensities to make the measurements reliable.

Yet another application of the barrier-layer cell is to the measurement of colour temperatures, which to-day is of great importance in the taking of colour films, and indeed of studio work wherever panchromatic material is being used. The colour temperature of noon sunlight is 5,400 deg K, that of the 500 W lamps frequently used in studio work is 2,760 deg K, while that of the photoflood lamps now so popular is 3,475 deg K. The high intensity sun arc has a colour temperature of 5,500 deg K, and so approximates to that of noon sunlight, although skylight can run as high as 18,000 deg K.

It will thus be seen that, as the lower the colour temperature of the illumination the redder the light, considerable inaccuracies can occur in motion picture photography, where some shots are taken in the studio and and others out of doors in various climates. Photoflood lamps with

their short life of a couple of hours deteriorate in blue/red ratio materially towards the end, and here the colour temperature meter is of real value in checking the quality of the light. When panchromatic film is used, the speed value in light of 5,000 deg K is roughly 1.8 times that of the speed under lighting of tungsten lamps of 2,360 deg K.

Without entering into a detailed description of these meters it may suffice to say that the general principle is to measure the relative response of the cell to two more or less equal parts of the spectrum—blue and red—by means of suitable light filters. In the "Eel" instrument the scale of the micro-ammeter is calibrated in both degrees Kelvin and micro-reciprocal degrees or mireds. The meter is directed towards the light source and held at eye or camera lens level; a photograph of the meter is seen in Fig. 4.

A more adequate arrangement for colour cinematography has been found in the use of three filters of the primary colours, each connected in turn with the photo-cell, and since the cell has a colour response of its own, it is an advantage to have three calibrated concentric scales on the dial. The ratio of photographic actinity of the light for any particular panchromatic material can be ascertained, and the appropriate correction filter for the lens computed.

Barrier-layer cells are used in absorptiometers which enable quantitative measurements of concentrations to be made by means of the colour of the solutions. Absorptiometric analysis is now widely used in biochemistry, brewing, metallurgy, sugar refining, sewage disposal and many other branches of chemistry. The Hilger biochemical absorptiometer is seen in Fig. 5, a compact and simple-to-use instrument provided with a set of eight spectrum filters by which measurements may be made of the concentration of a coloured solution by comparing it with that of a standard or a blank. The filter selected is of course complementary in colour (as far as possible) to that of the solution. As little as 4 millilitres of solution can be used in a 1 cm cell. The light from a controlled source passes through the cell on to the photo-cell, the current generated going to a micro-ammeter calibrated in densities where

$$\text{density} = \log_{10} \frac{\text{incident light}}{\text{transmitted light}}$$

A long-cell meter in which glass cells for containing the liquid varying from 2.5 mm to 100 mm in length can be used is made by Evans Electroselenium. This is seen in diagram form in Fig. 6. This instrument is fitted with nine spectrum filters and the light source is controlled by a step-down stabilising transformer which corrects for mains voltage variations over 10 per cent.

Gloss Measurement

For determining the gloss of painted surfaces the barrier-layer cell enables measurements to be made over the entire range from extreme matts to the highest gloss. A collimated beam of light is projected at an angle of 45 degrees on to the surface under test, from which it is reflected at the same angle on to the cell. This measures objective gloss, where a black or white surface of similar texture would show the same reading. For subjective gloss the telescope arm fitted with the cell is placed perpendicular to the surface under test. A well known gloss meter made by Sheen Instruments, Ltd., records the gloss on a linear scale.

The "Eel" gloss head has been developed specially to measure small differences in high gloss, having the illuminator and photo-cell unit each at 45 degrees to the specimen, which must be substantially flat. The specularly reflected light is collected by a lens in the cell housing and forms an image of the lamp filament at an aperture in a plate mounted in front of the cell. This aperture is slightly larger than the image of the filament and serves to cut off the light not specularly reflected from the sample.

Many other applications of barrier-layer cells are in daily use and the number is continually expanding. The "Eel" reflectance spectro-photometer is employed by many printing ink firms and others engaged in colour matching. The spectrum is divided into nine fairly well separated regions by means of glass filters mounted in a revolving disc, and although the transmission maxima of the filters is unequally spaced as to wave-length, charts are provided in which the ordinates of percentage reflectance are correspondingly biased.

The study of the separation of proteins by electrophoresis, the standardisation of laundry work, the estimation of sulphuretted hydrogen, of coal dust in mine atmospheres, etc., are examples of the many industrial applications. In practically all of these the outstanding feature of the barrier-layer cell in generating sufficient current to operate a comparatively robust form of measuring device gives it a predominant position in the industrial field where light is the evaluating element.

NEW BOOKS

Mains Practice. By T. H. Carr. Pp. 351; figs. George Newnes, Ltd., Tower House, Southampton Street, London, W.C.2. Price 35s.

This book is mainly intended for the power distribution and transmission engineer whether he is engaged on construction, system design or the general overall duties of the district engineer. From the point of view of the power supply engineer it provides a fund of interesting information covering a large range of problems associated with e.h.v. and l.v. distribution. The book commences with a chapter on general considerations which also includes a useful guide to the Electricity Acts and continues through the succeeding chapters on methods of transmission, methods of distribution, system design, systems of distribution, selection of plant, substations, cables, methods of cabling, joints, terminations and overhead lines and concludes with a very informative appendix on statutory procedure.

The three chapters on methods of distribution, system design and systems of distribution are particularly valuable both from the technical and economic viewpoint. There are a great number of useful diagrams which illustrate the many methods in which switchgear and transformers may be arranged to suit various distribution networks. The separate chapters devoted to both underground and overhead practice complete a work which adequately deals with the broad field of mains practice.

Altogether this book will be a useful addition to the library of any power supply engineer, particularly if he is engaged on planning. It is a good guide to the many aspects of the subject from the choice of substation sites, the selection and arrangement of gear and the considerations for future development.—F.B.C.

Der Transistor. By Joachim Dosse. Pp. 109; figs. R. Oldenbourg Verlag G.m.b.H., Rosenheimer Strasse 145, Munich, Germany. Price 11.80 DM.

Electronic Transformers and Circuits. By Reuben Lee. 2nd Edition. Pp. 360; figs. (John Wiley & Sons, Inc., New York) Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 60s.

Development of Power Cables. By P. V. Hunter, C.B.E., Hon.M.I.E.E., Fel.Am.I.E.E., M.R.I., D.F.H., and J. Temple Hazell, M.B.E., A.M.I.E.E. Pp. 150; figs. George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Price 25s.

Conditions of Contract and Insurance. By George T. N. Hagart, F.C.I.I. Pp. 127. Witherby & Co., Ltd., 15, Nicholas Lane, London, E.C.4. Price 10s.

NEW ELECTRICAL EQUIPMENT

Lagging Jacket

The "P.H." range of cylinder lagging jackets now available from P.H. THERMAL PRODUCTS, Westgate, Baildon, Yorkshire, are of the strip type and each strip is covered with a washable white plastic material. The

P.H. Thermal Products cylinder lagging jacket

strips are 7in wide and filled with a 1in nominal thickness of glass or mineral fibre having a thermal conductivity conforming with B.S. 1304. Three non-corrodible aluminium bands are provided for fixing purposes. Sizes are available for cylinders ranging in height from 36in up to 60in. As an indication of prices a jacket for a 36in cylinder with a diameter between 13 and 14in is £2 3s 9d and for the 60in cylinder size, having a diameter between 23 and 24in, the price is £5 17s 10d. Jackets of 1½ and 2in thicknesses can also be supplied.

Magnetic Valve

A new magnetic valve for air, water, light fuel oil and gas has been developed by TEDDINGTON INDUSTRIAL EQUIPMENT, LTD., Sunbury-on-Thames, Middlesex, and is scheduled for production shortly. The valve is pilot-operated and provides ⅜in full bore flow for liquids at pressures up to 150 lb/sq in or gases up to 250 lb/sq in. Arranged to open when energised, the valve is fitted with a continuously-rated coil and is robustly constructed for industrial use. Particular attention has, however, been given to size and weight to ensure that this new valve is equally suitable for oil-fired boilers, washing machines and other domestic appliances. The valve is being offered at a price which shows a substantial saving over those of similar size valves in the existing Teddington range.

Teddington magnetic valve

Fire Alarm

The latest item of fire alarm equipment designed by MADEWEL PRODUCTS, LTD., 1, Marsland Road, Sale, Manchester, meets the need for a simple and inexpensive method of alarm complying with the requirements of the Factories Act, 1937. Known as the "Tocsin" type MB/NF fire alarm unit, it consists of a sheet steel case

Madewel Products "Tocsin" type MB/NF fire alarm unit

which houses all the components and the emergency battery supply. The operating voltage, 6 V d.c., is normally derived from the mains supply via a small transformer and rectifier, but a mains/battery change-over relay automatically switches the emergency batteries into circuit on failure of the mains supply, reverting to mains working on resumption of the supply.

The fire alarm relay is connected in series with any number of "break the glass" operating buttons, thus providing a closed circuit system which is virtually foolproof. Tumbler switches may be used, any 6 V d.c. bell being suitable. All external wiring is low voltage.

Although designed primarily as a fire alarm unit, it may be used as a closed circuit burglar alarm, in which case door and window contacts would replace the "break the glass" buttons. The price is £12 10s (less batteries) plus £1 15s for "break the glass" buttons.

A further unit (type MB/WF) which will differentiate between a genuine fire call and an open circuit fault is also available, price £16 10s.

Battery Chargers

The new medium power battery chargers developed by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2, are lightweight industrial units designed particularly for the small garage or small vehicle owner requiring facilities for full rate as well as trickle charging. There are two models, one for charging up to two 12 V batteries at a maximum charging rate of 2½ A and the other for charging up to one 12 V battery at a maximum charging rate of 5 A. Each model can be supplied for use either in a temperate climate or in the tropics with temperatures over 35 deg C (95 deg F).

Both chargers are designed to give either a full rate charge or a trickle charge and when serving a 6 V battery can be scaled down to approximately ½ A.

The equipment includes an ammeter, a snap-action rotary switch and rotary resistance, providing coarse and fine control, an output fuse on the front panel, and two screwed captive output terminals marked positive and negative. To adjust the input supply, the rear panel is removed and the correct voltage selected by adjusting a fused plug at the rear of the transformer covering.

G.E.C. rectifiers with bridge type selenium cells to B.S. 2709 are used in the charger which has air-cooled double wound transformers with earthed screen to B.S. 171. Primary tappings are 200/220/240 V, 40/100 c/s. Secondary windings are suitably tapped for output voltage control and rectifier ageing.

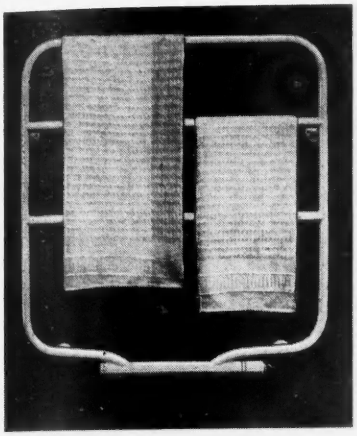
The battery chargers are housed in a sheet steel case finished in hammered

G.E.C. medium power battery charger

grey-green enamel and are suitable for wall or bench mounting. Overall dimensions are 11½in by 10½in by 13½in. The price of the charger for use in temperate climates is £16 7s 6d and for use in tropical climates £18 10s 6d.

Oil-filled Towel Rails

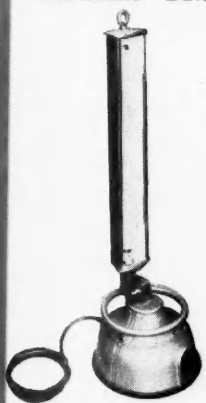
A new range of attractively styled oil-filled electric towel rails manufactured by DIMPLEX, LTD., Millbrook, Southampton, are suitable for either wall or floor mounting. Two types of finish are available, a chromium model with a loading of 200 W and a stoved enamel model with a loading of 250 W. Copper sheathed type elements are used. The overall length is 31¼in and depth 4½in. The height on feet is 35in and with wall brackets 33in. Finish of the stoved enamel models is cream or white; other colours can be supplied to order. Prices are £12 5s (chromium) plus £5 7s 6d purchase tax in the United Kingdom, and £7 12s 6d (stoved enamel) plus £3 7s P.T.



Dimplex wall mounting oil-filled towel rail

Fluorescent Lighting Unit

The "EDM 103" portable fluorescent lighting unit announced by ENGINEERING DEVELOPMENTS (ENGLAND), LTD., Mark Road, Hemel Hempstead, Herts, can be adjusted to throw a concentration of shadow-free light in any direction. The lamp, which is a 2ft 40 W fluorescent tube working on mains voltage, can be swivelled through 180 deg and the reflector tilted at any angle. In the horizontal position the lamp is only 10in high and can be slipped under vehicles or other objects and the reflector placed, if required, to throw the light directly upwards. The overall height with the lamp in a vertical position is 3ft 6in.



"EDM 103" portable fluorescent lighting unit (Engineering Developments (England), Ltd.)

In order that electric tools can be connected direct to the unit, a power plug is built into the base, which in addition contains all the necessary control gear. The makers claim that the unit is exceptionally strong and well able to stand up to the handling it can be expected to receive in garages and engineering workshops.

The price, which is not yet fixed, will be in the region of £27.

Safety Lamps

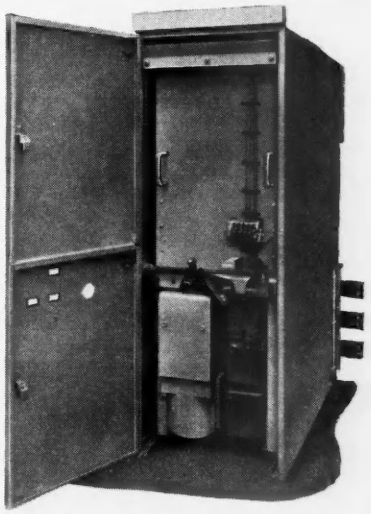
Two new lamps that can be operated with perfect safety in heavy concentrations of hydrogen, coal gas, coke oven gas, blue water gas and other gases of the pentane and petroleum groups have been developed by NIFE BATTERIES, Redditch, Worcs. Both are approved for this purpose by the Chief Electrical Inspector of Factories and meet the requirements of Home Office Specification JCDD/21.

Nife hydrogen cap lamp

One is designed to be worn on a helmet or suitable cap and a toughened plastic headpiece is connected by flexible lead to a stainless steel battery case at the waist. The other is similar in every respect except that a handle enables it to be used as a handlamp. The 1 A krypton gas-filled bulb is fitted into a specially designed reflector to provide an intense beam with wide angle diffusion. An alternative pilot bulb of low consumption conserves battery capacity when necessary. The battery is a Nife nickel-cadmium-alkaline type with a capacity of 12 Ah.

Air-break Switchgear

Following the development of a 3·3 kV air-break equipment for 150 MVA, the METROPOLITAN-VICKERS ELECTRICAL CO., LTD., Trafford Park, Manchester, 17, is now able to offer a modified design for 250 MVA. The new rating has been proved on test, and an ASTA certificate is in preparation. The 250 MVA equipment, known as type HSA, is of the draw-out pattern and is manufactured in ratings of 400, 800, 1,600 and 2,400 A. The interlocks are exceptionally complete and reliable and cable earthing is carried out without introducing a special device.



800 A type HSA Metropolitan-Vickers 3·3 kV, 150 MVA air-break switchgear unit

Built-in Refrigerator

A new built-in type refrigerator, M.170, has been introduced by ELECTROLUX, LTD., 153-155, Regent Street, London, W.1, as a successor to the M.151 model. The capacity is approximately 1¾ cu ft and shelf area 3·7 sq ft. Door shelves are now included. The refrigerator is designed to be built into kitchen fittings at waist height or floor level and may be installed with its main face flush with the surroundings, or with its side flanges overlapping the sides of the recess. It is finished in white or cream and it operates on the absorption principle. The price is £36 plus £16 6s 5d tax in the United Kingdom.

Electrolux M.170 built-in refrigerator

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 11th July from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1951

29923. Sylvania Electric Products, Inc.—Coating fluorescent lamp tube surfaces and the like. 20th December, 1951. (752451.)

1952

15480. British Broadcasting Corporation. —Automatic monitoring of telecommunications apparatus. 19th June, 1953. (752503.)

1953

8013 Electric & Musical Industries, Ltd. —Electron discharge devices. 15th March, 1954. (752452.)

13557. Krefft, H. E.—High pressure electrical discharge lamps. 14th May, 1953. (752454.)

1954

375. Westinghouse Brake & Signal Co., Ltd., and King, K. G.—Electric control apparatus. 3rd December, 1954. (752340.)

480. Licentia Patent-Verwaltungs-Ges.—Hollow tubular conductor for h.f. cables. 7th January, 1954. (752343.)

1024. General Electric Co.—P-N junction semi-conductors. 13th January, 1954. (752457.)

1118. Philips Electrical Industries, Ltd.—Oscillation generators with automatic frequency control. 14th January, 1954. (752558.)

2334. International Business Machines Corporation.—System for storage of differentially timed electrical signals. 26th January, 1954. (752566.)

2386. Benchemoul, N. R.—Electric relays of the conducting liquid type. 26th January, 1954. (752567.)

2629. Schwarz, B.—Rotating electrical amplifying generators. 27th April, 1955. (752355.)

5560. Erie Resistor Corporation. —Titanium dioxide capacitor. 25th February, 1954. (752670.)

2632. Ultra Electric, Ltd.—Density measuring device. 28th January, 1955. (752356.)

3085. General Electric Co., Ltd., and Biggs, A. J.—Colour television receivers. 2nd February, 1955. (752662.)

3216. Contraves Akt.-Ges.—H.f. contact bridge. 3rd February, 1954. (752663.)

3495. Radio Corporation of America.—Amplifier circuit for cascade-coupled transistor amplifiers. 5th February, 1954. (752574.)

3505. Compagnie pour la Fabrication des Compteurs et Matériel d'Usines à Gaz.—Electric change-over switches. 5th February, 1954. (752664.)

5128. Licentia Patent-Verwaltungs-Ges. —Testing installation for h.v. high capacity circuit-breakers. 22nd February, 1954. (752363.)

5559. Erie Resistor Corporation.—High dielectric constant ceramic cavity resonators. 25th February, 1954. (752467.)

5657. Bescol (Electric), Ltd.—Electric immersion heaters. 24th February, 1955. (752468.)

5779. British Thomson-Houston Co., Ltd. —Cements for bonding glass to other articles. 26th February, 1954. (752245.)

6140. Hoover, Ltd.—Food mixers. 2nd March, 1954. (752247.)

6177. Siemens & Halske Akt.-Ges.—Moving iron or moving coil electrical measuring instruments. 3rd March, 1954. (752471.)

7207. Sulzer Freres Soc. Anon.—Forced-flow steam generators in which the steam is generated at critical or supercritical pressure. 12th March, 1954. (752264.)

7348. Fligue, W. De, and Lavallee, P. L. —Polarised electric relays. 12th March, 1954. (752369.)

8092. Wells, R.—Electrical power equipment for operating a load or loads. 25th February, 1955. (752267.)

8539. Bosch Ges., R.—Wound electric condensers. 24th March, 1954. (752373.)

8906. Telefonbau und Normalzeit Ges.—Circuit arrangement for an automatic telephone exchange. 26th March, 1954. (752375.)

9026. T.I. (Group Services), Ltd.—Induction heating of metals. 7th March, 1955. (752268.)

9086/7. Pirelli Soc. Per Azioni.—Joints or terminals for h.v. electric cables. 29th March, 1954. (752376/7.)

9455. Paton Electrical Proprietary, Ltd.—Rotary multi-point electric switch. 24th May, 1954. (752379.)

10098. British Thomson-Houston Co., Ltd.—Electrical waveguide arrangements. 21st October, 1954. (752590.)

10539. Duss, F.—Portable electric hand drilling machines. 9th April, 1954. (752251.)

10751. Soc. Le Matériel Electrique S.W. —Control systems for d.c. motors. 12th April, 1954. (752252.)

11061. Maschinenfabrik Oerlikon.—Pre-electrode for electrolysers. 14th April, 1954. (752486.)

11524. General Electric Co.—Electrical time delay relays of the induction type. 21st April, 1954. (752488.)

11638. Northrop Aircraft, Inc.—Electrically-actuated step-by-step mechanism. 22nd April, 1954. (752490.)

11912. General Motors Corporation.—Electromagnetic motors for operating acoustic signal devices. 26th April, 1954. (752389.)

11940. Westinghouse Electric International Co.—Interlocks between electric switches and associated apparatus. 26th April, 1954. (752494.)

11985. Philips Electrical Industries, Ltd. —Circuits for automatic frequency correction. 26th April, 1954. (752390.)

13197. Bosch Ges., R.—Electrolytic condensers. 6th May, 1954. (752689.)

13840. Compagnie Générale d'Electricité.—Devices for detection of faults in very long electrical cables. 12th May, 1954. (752499.)

14032. Standard Telephones & Cables, Ltd.—Electric discharge devices. 13th May, 1954. (752694.)

14577. Engineering Research Corporation. —Capacitance-type fluid contents measuring apparatus. 18th May, 1954. (752699.)

15733. Philips Electrical Industries, Ltd. —Moving coils for use in instruments for measuring electric current or voltage. 27th May, 1954. (752504.)

15886. General Electric Co.—Cast-in windings in rotors for dynamo-electric machines. 28th May, 1954. (752406.)

16608. Standard Telephones & Cables, Ltd.—Preparation of germanium tetrachloride. 4th June, 1954. (752407.)

16617. M.L. Aviation Co., Ltd.—Flexible electrical conductors. 6th June, 1955. (752408.)

16793. Philips Electrical Industries, Ltd. —Piezo-electric quartz crystal plates. 8th June, 1954. (752274.)

17847. Shell Research, Ltd.—Process for the manufacture of an electrical insulating oil. 17th June, 1954. (752512.)

18022. Malek-Naegeli Ges.—Apparatus for the electrical testing of dental pulp vitality. 18th June, 1954. (752714.)

18179. Pestarini, J. M.—Electric self-synchronous systems. 21st June, 1954. (752278.)

18294. Penberthy, H. L.—Electrode assembly for glass furnaces. 22nd June, 1954. (752597.)

18567. Brush Group, Ltd.—Magnetic amplifiers. 23rd December, 1954. (752279.)

18917. Bendix Aviation Corporation.—Tuned resonant cavities or waveguides. 28th June, 1954. (752598.)

18937. Compagnie Générale de Télégraphie sans Fil.—Frequency modulated distance measuring equipments. 28th June, 1954. (752718.)

18969. Westinghouse Electric International Co.—Fluorescent screens. 29th June, 1954. (752283.)

19039. Western Electric Co., Inc.—Electrical circuits including semi-conductor devices. 29th June, 1954. (752412.)

19338. Naamlooze Vennootschap Coq.—Electric switching devices for high tension circuits. 1st July, 1954. (752601.)

20318. Philips Electrical Industries, Ltd. —Devices for reading magnetically recorded coded information. 12th July, 1954. (752415.)

20600. General Electric Co.—Photo-electric devices. 14th July, 1954. (752722.)

20980. Menke, J. F., and Doerpinghaus, E. H.—Electrical pellet primers. 19th July, 1954. (752724.)

21201. Philips Electrical Industries, Ltd. —Arrangements for stabilising the speed of a motor. 20th July, 1954. (752418.)

21568. Philips Electrical Industries, Ltd. —Frequency filters. 23rd July, 1954. (752726.)

21592. General Electric Co.—Dynamo-electric machines. 23rd July, 1954. (752419.)

21611. Telefunken Ges.—Neutralising circuit arrangements. 23rd July, 1954. (752727.)

21757. General Electric Co.—Food mixers. 26th July, 1954. (752729.)

22299. Standard Telephones & Cables, Ltd.—Method of producing selenium rectifier plates. 30th July, 1954. (752751.)

22818. Bendix Aviation Corporation.—Electro-acoustic transducers. 5th August, 1954. (752522.)

22970. Raysigns, Ltd.—Supporting fittings for tubular electric lamps. 6th August, 1954. (752754.)

23224. Philips Electrical Industries, Ltd. —Band-pass filters. 10th August, 1954. (752755.)

23780. Motor-Colombus Akt.-Ges. für Elektrische Unternehmungen. — Dielectric voltage transformer. 16th August, 1954. (752757.)

24035. Naamlooze Vennootschap Coq.—Current transformers. 18th August, 1954. (752613.)

24087. Staatsbedrijf der Posterijen, Telegrafie en Telefonie.—Arrangement for the step-by-step energisation of a directly working step-by-step switch with the aid of an impulse sender provided in common for several step-by-step switches. 18th August, 1954. (752614.)

24594. Western Electric Co., Inc.—Apparatus for coating wire with extruded insulating material. 24th August, 1954. (752616.)

24907. Avery, Ltd., W. & T. (Schenck Maschinenfabrik Ges., C.).—Electric measuring device for the determination of unbalance values by means of selective rectification. 27th August, 1954. (752735.)

25889. Sulzer Freres Soc. Anon.—Steam generating plants operating at supercritical pressure and temperature. 7th September, 1954. (752529.)

26341. Demag Zug Ges.—Electrically-operated pulley block. 10th September, 1954. (752530.)

27007. Standard Telephones & Cables, Ltd.—Multi-switch of the crossbar type. 17th September, 1954. (752622.)

27525. Tafel, J.—Protective systems for electrically driven pumps. 23rd September, 1954. (752305.)

[*Continued on page 49*

NEW PATENTS (*continued*)

27657. Philips Electrical Industries, Ltd. —Delta pulse-code modulation devices. 24th September, 1954. (752429.)

28082. General Motors Corporation.—Suction operated electric switches. 29th September, 1954. (752430.)

28359. Standard Telephones & Cables, Ltd.—Method of manufacturing selenium rectifier plates. 1st October, 1954. (752768.)

29062. Bose, J. H.—Noise reduction in phase shift carrier wave modulation systems. 8th October, 1954. (752628.)

29075. Telefonaktiebolaget L. M. Ericsson.—Devices for responding selectively to energy levels of modulated pulses in electrical pulse trains. 8th October, 1954. (752434.)

29112. Curtiss-Wright Corporation.—Simulated h.f. radio receiving apparatus for aircraft trainers. 8th October, 1954. (752629.)

29951. British Thomson-Houston Co., Ltd.—Sealing in apparatus for use in the manufacture of tubular electric lamps. 18th October, 1954. (752312.)

29980. Hoover, Ltd.—Suction cleaners. 18th October, 1954. (752635.)

30217. Soc. Francaise d'Equipements pour la Navigation Aerienne S.F.E.N.A.—Regulating the speed of an electric motor. 20th October, 1954. (752313.)

30563. Siemens-Schuckertwerke Akt.-Ges.—Determination of the distance of faults in electric cables and conductors. 22nd October, 1954. (752438.)

30673. Landis & Gyr Akt.-Ges.—Electric circuit for use with electromagnetically operated punches. 25th October, 1954. (752316.)

30676. Landis & Gyr Akt.-Ges.—Electricity meters. 25th October, 1954. (752439.)

31502. Heraeus Quarzschmelze Ges.—Production of envelopes for gas-discharge lamps. 1st November, 1954. (752774.)

31945. Soc. des Accumulateurs Fixés et de Traction.—Deferred action primary electric cells. 4th November, 1954. (752321.)

32687. Hazeltine Corporation. — Signal translating system for colour television receiver. 11th November, 1954. (752544.)

33203. Telefonaktiebolaget L. M. Ericsson.—Automatic emergency power connecting devices for burglar alarm installations. 16th November, 1954. (752545.)

34299. Telefunken Ges. für Drahtlose Telegraphie.—Accumulator charging arrangements suitable for portable radio equipment. 26th November, 1954. (752447.)

34779. Westinghouse Electric International Co.—Electric motor control systems. 1st December, 1954. (752549.)

34950. Naamlooze Vennootschap Coq. —Electric circuit-breakers with gas blast arc-quenching. 2nd December, 1954. (752782.)

36420. Standard Telephones & Cables, Ltd.—Electric cable manufacturing machines. 16th December, 1954. (752786.)

36651. Bignon, L. C. A. M.—Electric motors for windscreen wipers. 17th December, 1954. (752328.)

Norway's Imports and Exports

THE trend of Norway's electrical import trade last year was downward, the total value being Kr. 290,185,000 compared with Kr. 295,500,000 in 1954. The chief items, with notes of increases or decreases, are shown in the accompanying table. Conspicuous among the decreases were transformers, motors and switches, although motors remained by far the most valuable import. The decline spread through most radio and telephone material, cable and a range of installation goods. On the other hand there were increases in generators, accumulators and insulators. Norway's principal suppliers were West Germany with a total value of Kr. 100,084,000 against Kr. 96,500,000 in 1954, the United Kingdom Kr. 59,840,000 (Kr. 65,500,000), Sweden Kr. 47,181,000 (Kr. 46,625,000) and Denmark Kr. 24,320,000 (Kr. 23,500,000).

Higher Exports

Norway's electrical export trade last year expanded by over one-third in value compared with 1954 to a total of Kr. 28,854,000. The largest group was apparatus and parts for radio telegraphy and broadcasting, at Kr. 3,661,000 against Kr. 2,300,000 in 1954, followed by cable and wire Kr. 2,426,000 (Kr. 1,011,000) and radio receiving sets Kr. 2,065,000 (Kr. 1,267,000). Over one-third of the aggregate went to Sweden while Denmark's share rose to Kr. 3,640,000 (Kr. 1,324,000 in 1954).

Kr. 19·20=£1.

ELECTRICAL IMPORTS

Class of Equipment	1955 Kr. (000)	Inc. or dec. on 1954 Kr. (000)	Class of Equipment	1955 Kr. (000)	Inc. or dec. on 1954 Kr. (000)
Electric motors	54,018	— 3,714	Electric flat irons	2,514	— 672
Generators	33,411	+ 7,691	Electric meters	6,304	— 972
Transformers	5,444	— 6,542	Voltmeters, ammeters, etc.	1,690	— 307
Convertors, etc.	6,571	— 332	Other elec. recording instruments and parts	2,863	+ 137
Galvanic cells up to 180 gr	5,190	— 196	X-ray apparatus and parts	3,087	+ 849
Large switches and parts	16,440	— 2,675	Vacuum cleaners with built-in motors	8,496	+ 1,022
Incandescent lamps	10,845	— 268	Vacuum cleaner parts	2,564	+ 517
Radio valves	3,091	+ 88	Lead covered cable up to 40 mm diameter	4,088	— 785
Amplifiers	484	— 312	Ditto, 40 to 80 mm diam.	3,709	— 657
Other parts for receiving sets	2,732	+ 674	Ditto, over 80 mm diam.	20	— 62
Teletype sets	2,073	— 891	Other electrical wire	8,417	+ 616
Ultra short wave transmitters and receivers for telephony and parts	2,663	— 1,149	Accumulators and parts, excluding jars	4,085	+ 1,015
Other apparatus and parts for wireless telegraphy and broadcasting	7,805	— 3,333	Porcelain insulators h.v.	3,198	+ 601
Depth finders	4,345	+ 224	Ditto, l.v.	3,118	+ 356
Automatic switchboards and parts	2,279	— 1,064	Glass insulators	712	+ 278
Automatic telephone apparatus and parts	1,921	+ 482	Plastic insulators	1,070	— 34
Other telephone apparatus and parts	1,473	— 567	Switches for house installations	1,624	+ 134
			Lampholders, fuses, etc.	8,892	— 236

Street Lighting Notes

The Ministry of Transport has recommended the Ministry of Housing and Local Government to issue loan sanction for £24,055 for improved street lighting at WOKING.

SEAHAM U.D.C. is inviting tenders for improving the street lighting on trunk road A.19. The cost is estimated at about £4,700.

The surveyor to the BILLINGHAM (Co. Durham) U.D.C. is to prepare a scheme for installing class "A" lighting on the dual carriageways in Wolviston Road.

HEBBURN (Co. Durham) U.D.C. has called for a report on the cost of installing sodium lighting in place of the existing system.

STOCKTON-ON-TEES Town Council is to improve the electric lighting on a further section of trunk road A.19. The Council has decided to defer for six months a street lighting improvement scheme for Bowesfield Lane.

SMETHWICK Public Works Committee reports that the cost of public lighting scheme No. 4 is estimated at £44,520.

WIGAN Corporation is to seek sanction to borrow the sum of £14,000 to cover the cost of the conversion from gas to electricity of the street lighting in various parts of the town.

BARROW-IN-FURNESS Corporation is applying for sanction to borrow £10,720 for the conversion of street lighting from gas to electricity in Abbey Road, etc.

To cover the estimated cost of Stage 2 of its scheme for street lighting improvements, covering East India Dock Road from St. Leonard's Road to the western borough boundary, POPLAR Borough Council is to seek sanction to borrow £13,662.

MITCHAM Corporation is recommended to proceed with Stages 12 and 13 of its programme for improving the lighting of district roads. The estimated cost is £25,600.

Development in Quebec

A continued high rate of increase in volume of sales and an increasingly large expenditure on capital account to meet growing demands for the company's service were forecast by Mr. J. A. Fuller (president) at the annual meeting of shareholders of Quebec Power Company. Mr. Fuller noted that the volume of electricity sold in 1955 had increased 15·2 per cent over 1954, compared with an average rate of increase of 11·7 per cent since 1946. He termed the acceleration "very significant." Mr. J. N. Sicard (vice-president and general manager) pointed out that since 1946 the average annual consumption of electricity by domestic users had risen from 1,024 to 2,897 kWh.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Coseley.—16th July. U.D.C. Street lighting equipment. (See this issue.)

French Cameroons.—21st July. Delegation de l'Aeronautique Civile. Two diesel generating sets, three transformers, cable, lamps, etc. (E.S.B. 16098/56. Ten/20008.)*

Ilford.—24th July. Borough Council. Electrical installations in Highlands School and Goodmayes School. (See this issue.)

India.—21st August. India Store Department, London. Spares for wireless and station No. 62; junction remote control (1,000); 1,000 key and plug assemblies. (See this issue.)

27th August. Damodar Valley Corporation. Main and auxiliary power transformers for a thermal station. (E.S.B. 16240/56. Ten/19949.)*

Italy.—14th July. Ministero della Difesa-Aeronautica, Rome. Installation of lighting fittings, cables and control switchboards. (E.S.B. 16574/56. Ten/20006 and E.S.B. 16575/56. Ten/2005.)*

16th July. Ministero della Difesa-Marina, Rome. Electrical plant for a naval base power station. (E.S.B. 16605/56. Ten/19994.)* 25th July. Four transformers for a naval base power station. (E.S.B. 16676/56. Ten/20011.)*

Jedburgh.—Burgh Council. Street lighting equipment. (See this issue.)

Lanark.—23rd July. County Council. Street lighting equipment. (See this issue.)

New Zealand.—1st August. General Post Office. Twelve oscillating electric fans. (E.S.B. 15938/56. Ten/19924.)*

Nuneaton.—24th July. Borough Council. Street lighting equipment. (See this issue.)

Pakistan.—24th July. Posts and Telegraphs Department. Underwater cable. (E.S.B. 16588/56. Ten/20014.)*

South Africa.—12th July. City of Johannesburg. Four fixed transmitter-receiver stations. (E.S.B. 16169/56. Ten/19951.)* 16th July. 216 distribution transformers, 100 to 400 kVA. (E.S.B. 16454/56. Ten/20026.)*

25th July. Stores Department, South African Railways. Cable. (E.S.B. 16317/56. Ten/19981.)*

Southern Rhodesia.—28th July. Rhodesia Railways. Two induction type heating units. (E.S.B. 16297/56. Ten/19989 and E.S.B. 16296/56. Ten/19990.)*

7th August. City of Salisbury. Sewage motor pump sets. (E.S.B. 16226/8/5/9/3/7. Ten/19952/3/4/5/6/7.)*

Stockport.—18th July. Borough Council. Electrically-operated passenger lift at Brinnington aged persons' home. Borough architect, Town Hall.

United States.—17th July. Garrison District Corps of Engineers, North Dakota. Two 55,000 h.p. hydraulic turbines. (E.S.B. 15400/56. Ten/19944.)*

ORDERS PLACED

Alton (Hants).—U.D.C. Electrical wiring of 88 pre-war Council houses (£1,386).—Southern Electricity Board.

Carlisle.—City Council. Electrical installations in 42 houses on the Morton estate (£1,076).—Hartley Electromotives, Ltd.

Tynemouth.—Corporation. Electrical installations in 66 houses at West Chirton (£1,885).—T. Kitchenman.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Ayr.—Houses (104), Main Road, Whitletts; burgh surveyor.

Banbury.—Maternity unit for Horton General Hospital; Ernest G. Phillips, Son & Norfolk, consulting engineers, Annesley Grove, Nottingham.

Barrow-in-Furness.—Works, Ormsgill; Sir Elkanah Armitage & Sons, Ltd., Pendleton New Mills, Manchester.

Battle.—Houses (26) at Northiam; R.D.C. surveyor, Council Offices, The Watch Oak, Battle, East Sussex.

Birmingham.—Laboratories for cancer research department of the University, on site near Queen Elizabeth Hospital (£55,000); University House, Edgbaston Park Road, Selly Oak, Birmingham, 15.

Houses (112), Church Road, Perry Barr, for House Building Committee; A. G. Sheppard Fidler, city architect, Civic Centre, 1.

Bishop's Waltham.—Houses (26) for Droxford R.D.C.; B. C. E. Butcher, clerk, Northbrook House, Bishop's Waltham, Southampton.

Blackpool.—Houses (60), Grange Park estate; borough surveyor.

Bletchley.—Factory, Watling Street; Gilham & Horsman, Ltd., builders, 154, Bletchley Road.

Brentford and Chiswick.—Hogarth Primary Schools (£105,358); J. Lawson & Co., Ltd., builders, 28, Park Road North, London, W.3.

Carlisle.—Secondary school at Harraby (£101,000) and school for subnormal children (£40,000); L. J. A. Stow, city engineer, 18, Fisher Street.

Catterick Camp (Yorks).—Primary school for North Riding E.C.; Johns Slater and Haward, architects, Foundation Street, Ipswich.

Coalville.—Grammar school on Castle Rock site (£177,000); county architect, Leicester.

Coleraine.—Factory; Ballantyne Sportswear Co., Ltd., Innerleithen, Peebles.

Crowle. — Secondary modern school (£113,746), for Lindsey C.C.; G. Chessman, builder, Scotter Road, Scunthorpe.

Dorchester. — Houses (44), Poundbury estate, for T.C.; Rawlings (Builders), Ltd., New Quay Road, Hamworthy, Poole.

Eccles.—Metallurgical block for Mitchell, Shackleton & Co., Ltd., Vulcan Works, Patricroft; E. Tonge & Sons, Ltd., builders, Station Road, Swinton.

Felling (Co. Durham).—Factory, Tyne Street, for International Paint Co., Ltd., Felling; own architects.

Hexham.—Houses (40) at West Wylam for the R.D.C.; William Leech, Ltd., builders, St. James Street, Newcastle-on-Tyne.

Huddersfield.—Voluntary school, Rawthorpe (£44,000); Harry Bann, town clerk, Town Hall.

Factory at Honley, for Brook Motors, Ltd.; Noel Heppenstall, architect, 135, Armitage Road, Milnsbridge, Huddersfield.

Hull.—Works, offices and stores, Clay Street; F. Hall & Sons, Ltd., 61, Alexandra Road.

Houses (238), on Greatfield estate; A. Rankine, city architect, Lowgate.

Ilford.—Synagogue, hall and classrooms, Beehive Lane; Norman Green, architect, 12, Adeline Place, London, W.C.1.

Houses (38) on sites at Crabtree Avenue and Heathcote Avenue (Contracts A and B); borough engineer, Town Hall.

Kingston-on-Thames.—Out-patients' block, Kingston Hospital; Gordon Jeeves, architect, 61, Catherine Place, London, S.W.1.

Langley Mill.—Foundry, Cromford Road; Canlin & Bowmer, Derby Road.

London.—Group pathological laboratory, St. Mary Abbots Hospital, Kensington; S.W. Metropolitan Regional Hospital Board, 76, Wimpole Street, W.1.

Factory, Cambridge Heath Road, Stepney; Soar & Co., Ltd., 231, Lower Road, S.E.16.

Assembly hall for Westminster Technical College, Westminster; H. S. Goodhart-Rendel & Partners, architects, 22, Whitehall, S.W.1.

Factory, Woolwich; G. & F. Holdsworth, Ltd., White Hart Road, S.E.18.

Houses (127), as development of the Springfield Rise site, Sydenham Hill estate, Lewisham (£381,660); Dr. J. L. Martin, L.C.C. Architects' Department, County Hall, Westminster Bridge, S.E.1.

Seven-storey municipal college, High Street South, East Ham; H. A. Edwards, town clerk, Town Hall, E.6.

Loughborough.—Handicraft workshops at training college (£55,000); county architect, Leicester.

Middlesbrough.—Accident and orthopædic department at General Hospital, for Newcastle Regional Hospital Board; secretary to the Board, Walker Gate Hospital, Benfield Road, Newcastle-on-Tyne.

R.C. school at Berwick Hills; T. Crawford, architect, 80, Borough Road.

Newcastle-on-Tyne.—Presbyterian church, Montague estate; Tasker and Child, architects, 25, New Bridge Street.

North Riding.—School at Osbaldwick for the E.C.; Atkinson and Sons, architects, Raymond Buildings, Grays Inn, London, W.C.1.

School at Linton R.A.F. station (£21,500); D. W. Dickenson, county architect, County Hall, Northallerton.

Penrith.—Houses (40) on the Scaws estate; F. Birkbeck, U.D.C. surveyor.

Portsmouth—Houses (100), Park House Farm, Leigh Park, and flats and maisonnettes (50) on the Bishop Street/Kent Street site, Portsea; J. Parkin, city engineer, 1, Clarence Parade.

Reading.—Flats (30), Bath Road; Beeson Bros., builders, Tidmarsh Road, Tidmarsh.

Redditch.—Factory on Arthur Street estate; W. H. Smart & Co., Ltd., bacon curers, etc., of Wrentham Street, Birmingham, 5.

Rotherham.—Council offices; R.D.C. surveyor, Grove Road, Moorgate.

Ice cream depot, Erskine Road, for T. Wall & Sons, Ltd.; Broadbent. Thompson & Wilson, architects, Hillary Chambers, Hillary Place, Leeds, 2.

Stamford (Lincs).—Houses (42) on Drift estate; Morton Potter, Ltd., Barkby Road, Leicester.

C. of E. secondary modern school in Empingham Road; Edward Craven, architect, Stamford, Lincs.

Swansea.—Four-storey hostel on the George Street/St. Helens Road corner site, for the Merchant Navy Welfare Board; regional officer, Merchant Navy House, Tudor Street, Cardiff.

Uxbridge.—Dwellings (50), Lees Road estate; borough surveyor.

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).